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EVAPORATION RATES OF CHEMICAL WARFARE AGENTS MEASURED USING 5 CM WIND TUNNELS III. MUNITION-GRADE SULFUR MUSTARD ON CONCRETE

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PREFACE

The work described in this report was authorized under Contract No. DAAD13-03-D-0017. This work was started in July 2006 and completed in May 2009.

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CONTENTS

1.	INTRODUCTION	9
2.	EXPERIMENTAL PROCEDURES	9
2.1	Wind Tunnel	9
2.2	Agent.....	10
2.3	GC with MS Detection.....	10
2.4	Substrates	10
2.5	Experimental Design and Data Analysis	12
3.	RESULTS AND DISCUSSION	13
3.1	Munition-grade H on Concrete	13
3.2	Comparison of Glass, Sand, and Concrete.....	20
3.3	Recommendations for Future Projects.....	23
4.	CONCLUSIONS.....	23
	LITERATURE CITED	25
	APPENDIXES	
	A - NITROGEN GAS ADSORPTION DATA FOR CONCRETE C04.....	A-1
	B - MIP DATA FOR CONCRETE C04.....	B-1
	C - MICROPORE DATA FOR A MINISLAB OF C04	C-1
	D - ENVIRONMENTAL FACTORS AND EVAPORATION RATES FOR INDIVIDUAL EXPERIMENTS.....	D-1
	E - WIND TUNNEL DATA	E-1

FIGURES

1.	C04 Concrete Showing Large and Small Aggregate	11
2.	C04 Concrete Showing Rippled Top Surface	12
3.	Molded Bottom Surface of C04 Concrete	12
4.	Distributions of (a) %Vapor Recovered, (b) Raw Evaporation Rate, and (c) Log_{10} (Raw Evaporation Rate)	14
5.	Evaporation of Munition-grade H from Concrete	15
6.	Evaporation Rate Ranges Observed for Munition-grade Sulfur Mustard Vapor Evaporating from Concrete	15
7.	Plot of (a) Actual vs. Predicted Values and (b) Residuals for Least Squares Fit for Raw Evaporation Rate of Sulfur Mustard from C04 Concrete	16
8.	Plot of (a) Actual vs. Predicted Values and (b) Residuals for Log_{10} (Raw Evaporation Rate) of Sulfur Mustard from C04 Concrete	17
9.	Evaporation of H from Concrete: Comparison of HD on Bottom (■) and H on Rippled Top Surface (▲) to H on Bottom (◇)	18
10.	Evaporation of H from Concrete: Comparison of HD on Bottom (■) and H on Rippled Top Surface (▲) to H on Bottom (◇)	18
11.	Comparison of H Evaporation from Molded (NM), Rippled (R), and Rippled Weathered (RW) C04 Concrete	19
12.	Plot of Vapor Concentration vs. Time for Evaporation of Munition- grade Sulfur Mustard (H) from Glass (△), Sand (□), and Concrete (●) at 35 °C, 6 µL Drop, 181 SLPM Air Flow	21
13.	Cube Plot Showing Average Evaporation Rates of HD from Glass (G), and H from Sand (S) and Concrete (C).....	21
14.	Prediction of Evaporation Rates of Sulfur Mustard: HD from Glass (◇), H from Sands (□), and H from Concrete (△) Using Equation Derived for Glass	22

15.	Prediction of Log_{10} (Evaporation Rates) of Sulfur Mustard: HD from Glass (\diamond), H from Sands (\square), and H from Concrete (\triangle) Using Equation Derived for Glass	22
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TABLES

1.	Physical Properties of C04 Concrete	11
2.	Statistical Results for Evaporation of Sulfur Mustard from C04 Concrete	15
3.	Summary of Fit for Evaporation Rate of Sulfur Mustard from C04 Concrete	16
4.	Statistical Results for Evaporation Rate of Sulfur Mustard from C04 Concrete	16
5.	Comparison of Means for One-way ANOVA for Raw Evaporation Rate of H and HD on Concrete Surfaces	19

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EVAPORATION RATES OF CHEMICAL WARFARE AGENTS
MEASURED USING 5 CM WIND TUNNELS
III. MUNITION-GRADE SULFUR MUSTARD ON CONCRETE

1. INTRODUCTION

The evaporation rate of the vesicant chemical warfare agent, sulfur mustard ($\{ \text{bis}(2\text{-chloroethyl}) \text{ sulfide, } (\text{ClCH}_2\text{CH}_2)_2\text{S} \}$, abbreviated H), from glass and three types of sand has been previously reported.^{1,2} In this work, the evaporation of 77% pure munition-grade sulfur mustard from concrete was measured.

The design of the 5 cm laboratory-sized wind tunnels³ and the wind tunnel characteristics^{4,5} compared to other wind tunnel and outdoor measurements have been published. The vapors of sulfur mustard were collected using thermal desorption tubes and quantified using standard methodology. This report describes how the data were analyzed and demonstrates the robustness of the set of data that will be passed to the modelers for eventual incorporation into field models such as VLSTRACK. Comparisons to previous agent evaporation data are provided.

2. EXPERIMENTAL PROCEDURES

2.1 Wind Tunnel

The 5 cm wind tunnels that were used in the present investigations have been previously described, and are the same as those used for similar earlier studies on glass.⁶ In order to expose the agent to the wind flow, the piston was removed and the test substrate (a 1.5 in. diameter circle) with the droplet of agent on it was placed onto the piston and inserted into the wind tunnel. The humidified, temperature-controlled air from a Miller-Nelson Environmental Control Unit ([ECU] tunnel a) or an Aalborg MFC (tunnels c, d, k, and l) was then passed over the sample, and the vapors were collected on Markes Tenax[®] thermal desorption tubes at the vapor sampling inlet. The amount of agent on each tube was measured based upon a standard in the Gas Chromatography/Mass Spectrometry (GC/MS). The sample volume and tunnel air flow rate were known, thus the agent concentration (mg/m^3) and evaporation rate ($\mu\text{g}/\text{min}$) could be calculated. The rates were not calculated for the initial 5 min of the experiment, before the instrumentation had reached equilibrium, nor at the end of the experiment, when the concentration of mustard was nearing a plateau due to sample exhaustion. Hence, the data in the middle of each experimental run were used to calculate the evaporation rates.

Air flows were 18, 181, and 405 standard liters per minute (SLPM), which corresponded to velocity values at a 1 cm height of 0.22, 1.7 and 3.6 m/sec. The flow volume per thermal desorption tube was typically 2 to 10 L volume, and the tubes were automatically switched using a proprietary Versatile Tube Sampler. The rate at which the tubes were switched was adjusted based upon the evaporation rate of the agent. The air and substrate temperatures

investigated in this work were 15, 35, and 50 °C, and the droplet sizes were 1, 6, and 9 μL , corresponding to droplet diameters of 1.24, 2.25, and 2.58 mm and contamination densities of ~ 1.3 , 7, and 11 g/m^2 .

The droplet masses used in the calculations and tables were based upon the pipette setting; the samples were not weighed due to the small mass of agent compared to the much larger mass of the concrete.

2.2 Agent

Sulfur mustard, {bis(2-chloroethyl) sulfide, $(\text{ClCH}_2\text{CH}_2)_2\text{S}$ }, is commonly abbreviated H for munition-grade and HD for distilled agent. Distillation removes the impurities that are commonly present in munition-grade mustard, including Q (sesquimustard, bis(2-chloroethylthio) ethane, $\text{ClCH}_2\text{CH}_2\text{SCH}_2\text{CH}_2\text{SCH}_2\text{CH}_2\text{Cl}$, 10.1%) the cyclic ether 1,4-dithiane, $(\text{S}(\text{CH}_2\text{CH}_2)_2)_2$, 3.2%), 1,2-dichloroethane (2.6%) and 4-chlorobutyl 2-chloroethyl sulfide (1.0%), and 16 other analytes (totaling 3.9%). **Caution: sulfur mustard is a potent vesicant, and care must be taken to prevent exposure to liquid or vapor. It should only be manipulated by trained personnel employing appropriate engineering controls and personal protective equipment.**

2.3 GC with MS Detection

The protocol used in the present work was the same as that used for the studies of the evaporation of HD from glass and H from sand. GC/MS analysis of the thermal desorption tubes was performed using a Markes UNITY/ULTRA Thermal Desorption system connected to an Agilent Technologies 6890N GC/5973 MSD equipped with a 30 m x 0.25 mm HP-5 capillary column (Agilent Technologies, Wilmington, DE). The thermal desorption tubes used were Markes Tenax thermal desorption tubes (Markes International, Llantrisant, UK, Part #C0102S). Each sample was prepurged for 1 min and then desorbed for 2.5 min at 250 °C. The transfer line to the GC was heated to 180 °C. The GC oven temperature profile was ramped from 75 °C (2 min), to 110 °C at 20 °C/min, to 290 °C at 80 °C/min. The column flow rate (at 75 °C) was 1.6 mL/min (46 cm/sec) at a constant pressure of 15 psig. The temperatures were injection at 250 °C; MSD transfer line at 180 °C; MSD quadrupole at 150 °C; and MSD source at 230 °C. The sample extracts were analyzed in the electron impact (EI) mode scanning from 30-300 amu, with 2.78 scans/sec. Under these conditions, HD eluted at ~ 2 min (Figure 2). Both sulfur mustard and a breakdown ion were seen in the mass spectrum (Figure 3).

2.4 Substrates

The concrete (C04) was the same as that used in previous sulfur mustard degradation studies.^{7,8} The C04 concrete had the nominal formulation of 16.5% Portland cement, 34.2% natural river siliceous sand as fine aggregate, 49.3% Caldcra Alabama limestone coarse aggregate, which was ~ 1 cm in diameter (Figure 1), and a 0.45 water-to-cement ratio. The concrete was made in 2004 and was ~ 2 years old when used. Both nitrogen gas absorption and mercury intrusion porosimetry (MIP) were used to determine the pore diameter and volume

of small monoliths of concrete (Table 1, Appendices A, B, and C)* The concrete samples submitted for measurement were chunks of ~0.5 mm diameter; the large aggregate was eliminated due to the size requirements of the instrumentation used. The pH of water in which the concrete was submerged for 24 h was 12 (0.2 g concrete in 2 mL water). The higher surface area and pore volume observed from the MIP experiments may be due to the pressure of the mercury breaking smaller pore walls within the concrete, and thus creating surface area as the experiment progressed. The top side of the concrete had been brushed before curing to give a rippled effect (Figure 2); the ripples were about 1 cm in wavelength. The bottom of the concrete was the side that had been in the mold; a mold release agent had been used. The bottom surface was porous with visible pores that were 1-2 mm in diameter and aggregate was seen on the bottom surface. Most of the samples were spiked on the bottom of the concrete; a few were spiked on the rippled top side and are annotated 'R' in the list of data in Appendix D. A few samples of concrete were artificially 'weathered' by abrasion against an outdoor piece of concrete on the rippled side; these are annotated 'RW' in the Tables.

Table 1. Physical Properties of C04 Concrete.

	N ₂ Gas Adsorption	MIP
Average pore diameter (μ)	0.035	0.022
Skeletal Density (g/mL)	Not measured	2.54
Surface Area (m ² /g) minislabs	3.05	10.4
Micropore Surface Area (m ² /g) minislabs	0.295	Not measured
Pore Volume (cc/g) minislabs	0.027	0.057
%Porosity	Not measured	12.7

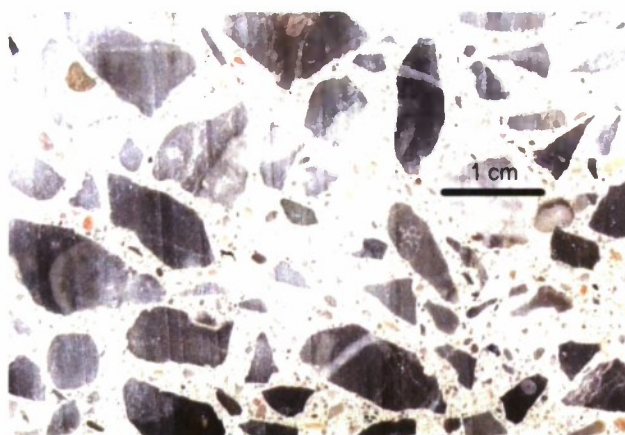


Figure 1. C04 Concrete Showing Large and Small Aggregate.

* Measurements Made by Micromeritics Inc., One Micromeritics Drive, Norcross, GA.

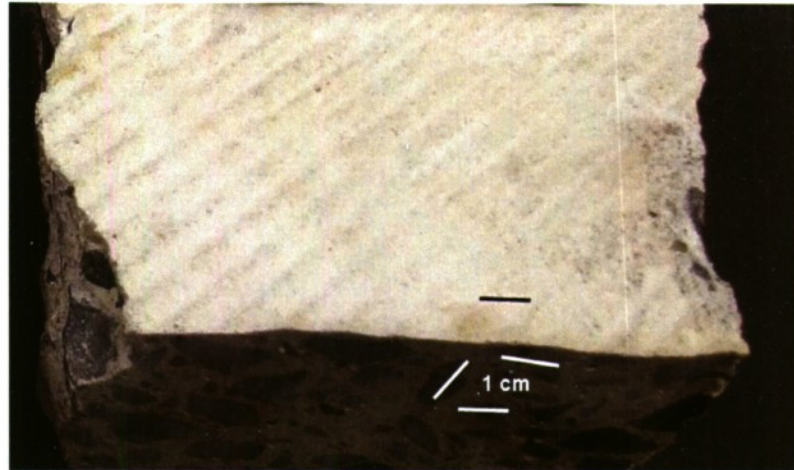


Figure 2. C04 Concrete Showing Rippled Top Surface.

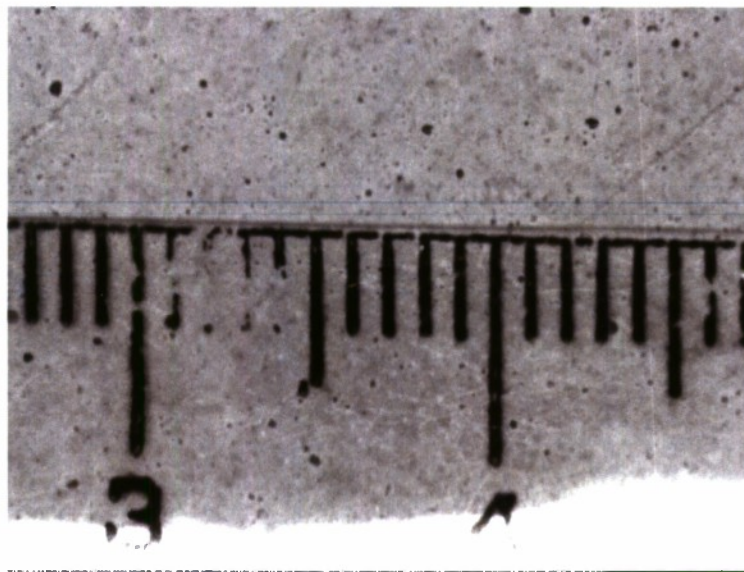


Figure 3. Molded Bottom Surface of C04 Concrete. The dark spots are pores and the smaller lines on the scale depict 1 mm intervals.

2.5 Experimental Design and Data Analysis

The experimental design was generated and the data were analyzed using JMP[®] Statistical Discovery Software. The three variables were temperature, drop size, and air flow rate at three levels each. Measuring all combinations of these levels would yield 27 conditions ($3 \times 3 \times 3$); the cubic composite design chosen required 9 conditions, which can be described as the vertices of a cube and the cube's center. The data were collected in triplicate as two blocks of four vertices (chosen as the corners of a tetrahedron) and the mid-point. This collection of

data allowed for the determination of the major contributing variables and interactions among variables. The substrate temperature (°C), droplet mass (mg), air flow (SLPM), total percent sulfur mustard recovered, and tunnel identity (three similar 5 cm tunnels, named a, c, and d, were available) were treated as variables that may affect the raw evaporation rate. Effect interactions among droplet mass, air flow, and temperature were included in the numerical analysis.

3. RESULTS AND DISCUSSION

3.1 Munition-grade H on Concrete

Sixty-one experiments were performed and two low-temperature datasets were removed as outliers based on the statistical analyses (original wind tunnel vapor concentrations are shown in Appendix E). Least squares regression analyses were performed with the 44 experiments that were munition-grade on the molded side of the C04, and the formulae were applied to the rippled surfaces with H and the molded side with HD to compare the fit of the data (Appendix D). Relative humidity (RH) was not tested as a factor because of the paucity of the data and the recent results that suggest that RH has little or no influence on HD volatility.⁹ The identity of the tunnel had no discernable effect on the evaporation rate.

The average vapor recovery of the agent was 53% and the 95% confidence range was 47 to 60% (Figure 4a, Table 2). By comparison, the vapor recovery was 75% from sand and 86% from glass using the vapor method. Photographs showed that the evaporation from glass was 100%. Thus, the 53% recovery of agent from concrete and sand may be corrected to 67%. Because sulfur mustard was left in the concrete, the reactivity, degradation, and transport in the concrete must be studied in order to determine the final fate of the sulfur mustard.

Prior analyses of the evaporation data of HD on glass showed that normalization of each evaporation curve to 100% provided a set of consistent rates.¹⁰ Analysis of the HD on glass data using normalized evaporation rates or the raw evaporation rate plus the fractional vapor recovery yielded the same result. Thus, the same method was used to analyze the concrete data.

The evaporation rate of the sulfur mustard increased while spreading over the surface of the concrete, then decreased quickly as the surface contamination was exhausted, and the balance of the agent was trapped in the concrete (Figure 5). The evaporation rate was calculated from the decreasing sulfur mustard concentrations after the agent had spread, which corresponded to about 0.25 h in Figure 5.

The variation of evaporation rate with temperature, drop size, and wind speed is shown in the cubic plot in Figure 6. The bulk of the experiments were performed on the molded surface. The experiments performed on the rippled surface are written in brackets and tagged (R). The average evaporation rates from the rippled surface are lower than those from the molded surface. The distributions of the raw evaporation rate and $\log_{10}(\text{evaporation rate})$ (Figures 4b and 4c, Table 2) are based on the 44 experiments on the molded surface (Table E1).

A least squares regression analysis method was used to fit the evaporation rates from the molded surface to the variables of drop size, wind speed, and air flow; $r^2 = 0.77$; $r^2_{adj} = 0.72$, $n = 44$ (Figure 7, Tables 3 and 4). The $\log_{10}(\text{evaporation rate})$ was similarly calculated and predicted, with $r^2 = 0.74$; $r^2_{adj} = 0.68$, $n = 44$ (Figure 8, Tables 3 and 4). Unlike the analyses of the glass and sand data, the r^2 was higher for the raw evaporation rates than for the $\log_{10}(\text{evaporation rate})$. The negative intercept for the regression line may reflect the fact that the evaporation rates were low at 15 °C, which was close to the freezing point of sulfur mustard (14.5 °C).

Raw Evaporation Rate =

$$\begin{aligned} & -108 + (2.2 * \text{temp}) + (6.1 * \text{H mass only}) + (0.11 * \text{SLPM}) \\ & + 0.19(\text{temp}-35.4)*(\text{H mass only}-5.6) + 0.005(\text{temp}-35.4)*(\text{SLPM}-177.9) \end{aligned} \quad (1)$$

$\log_{10}(\text{Raw Evaporation Rate}) =$

$$\begin{aligned} & (0.02 * \text{temp}) + (0.06 * \text{H mass only}) + (0.0008 * \%RH) \\ & + (0.006 * \% \text{vapor recovered}) \end{aligned} \quad (2)$$

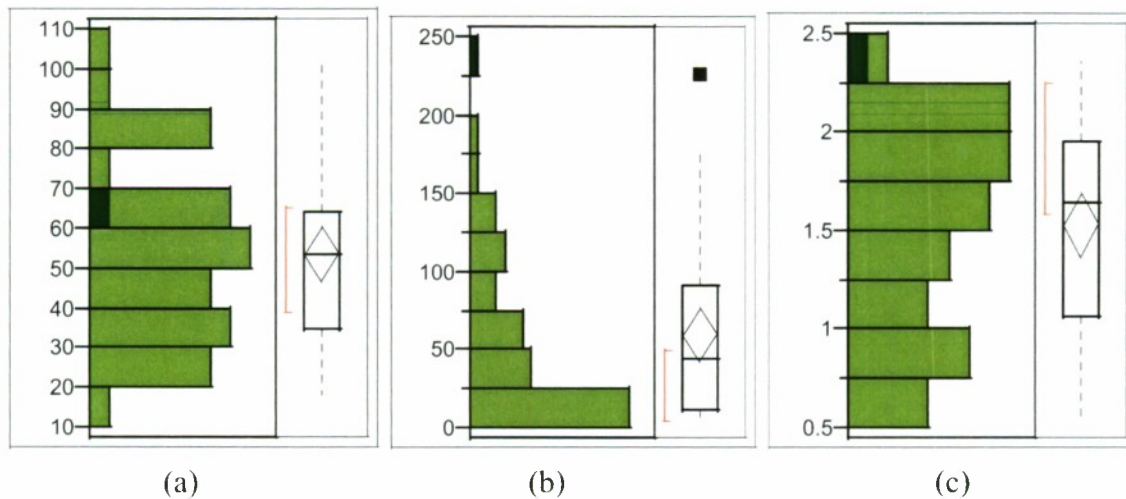


Figure 4. Distributions of (a) %Vapor Recovered, (b) Raw Evaporation Rate, and (c) $\log_{10}(\text{Raw Evaporation Rate})$. The dark boxes in the distributions correspond to the highest evaporation rate sample; the rectangles correspond to the 25th and 75th quartiles; the line in the rectangles corresponds to the mean; and the diamonds correspond to the 95% confidence interval.

Table 2. Statistical Results for Evaporation of Sulfur Mustard from C04 Concrete.

	%vapor recovered	Raw evaporation rate ($\mu\text{g}/\text{min}$)	$\log_{10}(\text{raw evaporation rate})$
Mean	53	59	1.53
Std Dev	21	Not relevant ^a	Not relevant ^a
Std Err Mean	3.1	Not relevant ^a	Not relevant ^a
upper 95% Mean	60	76	1.69
lower 95% Mean	47	42	1.37
Number of samples	44	44	44

^aThere is no reason to expect the evaporation rates to cluster around a mean value; a broad range was anticipated.

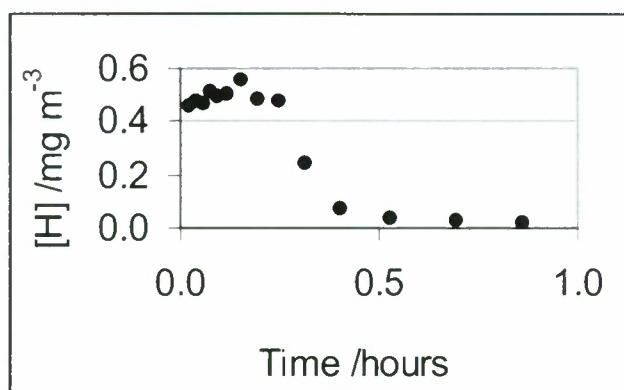


Figure 5. Evaporation of Muniton-grade H from Concrete (6 μL , 42 °C, 182 SLPM).

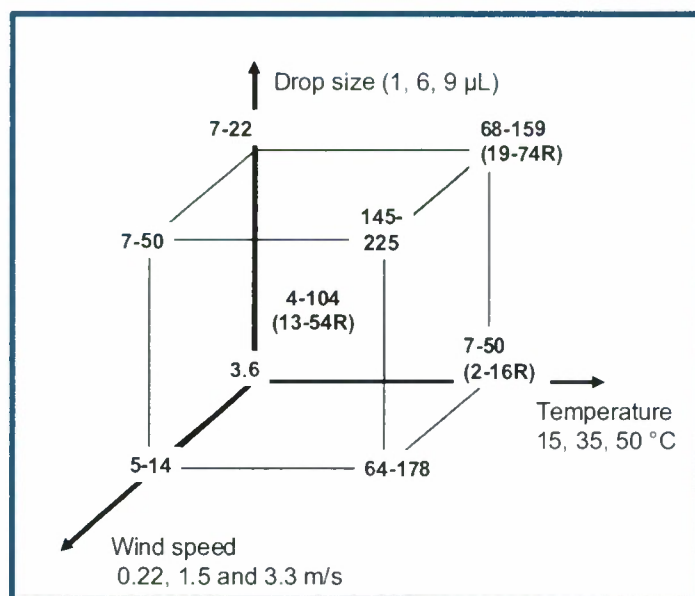


Figure 6. Evaporation Rate Ranges ($\mu\text{g}/\text{min}$) Observed for Muniton-grade Sulfur Mustard Vapor Evaporating from Concrete.

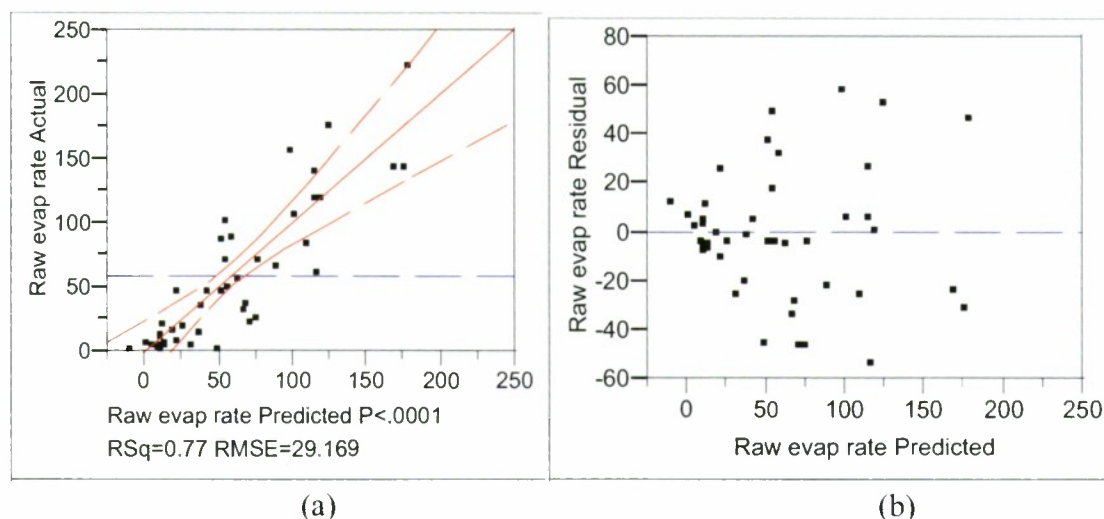


Figure 7. Plot of (a) Actual vs. Predicted Values (dashed lines are the 95% confidence intervals) and (b) Residuals for Least Squares Fit for Raw Evaporation Rate ($\mu\text{g}/\text{min}$) of Sulfur Mustard from C04 Concrete.

Table 3. Summary of Fit for Evaporation Rate of Sulfur Mustard from C04 Concrete.

	Raw Evaporation Rate	$\text{Log}_{10}(\text{Raw Evaporation Rate})$
r^2	0.77	0.74
r^2_{Adj}	0.72	0.68
Root Mean Square Error	29.2	0.29
Mean of Response	59.2	1.52
Number of Observations	44	44

Table 4. Statistical Results for Evaporation Rate ($\mu\text{g}/\text{min}$) of Sulfur Mustard from C04 Concrete

Term	Raw Evaporation Rate			$\text{Log}_{10}(\text{Evaporation Rate})$		
	Estimate	Std Error	Prob> t	Estimate	Std Error	Prob> t
Intercept	-108	18	<0.0001	nss ^a	nss	nss
Temperature /°C	2.2	0.3	<0.0001	0.023	0.003	<.0001
H mass only, mg	6.1	1.3	<0.0001	0.06	0.01	<.0001
SLPM	0.11	0.03	0.0006	0.0008	0.0003	0.0075
%vapor recovered	0.8	0.3	0.0073	0.006	0.003	0.0189
(temp-35.4)*(H mass only-5.6)	0.19	0.07	0.0178	nss	nss	nss
(temp-35.4)*(SLPM-177.9)	0.005	0.002	0.0059	nss	nss	nss

^anss Not statistically significant.

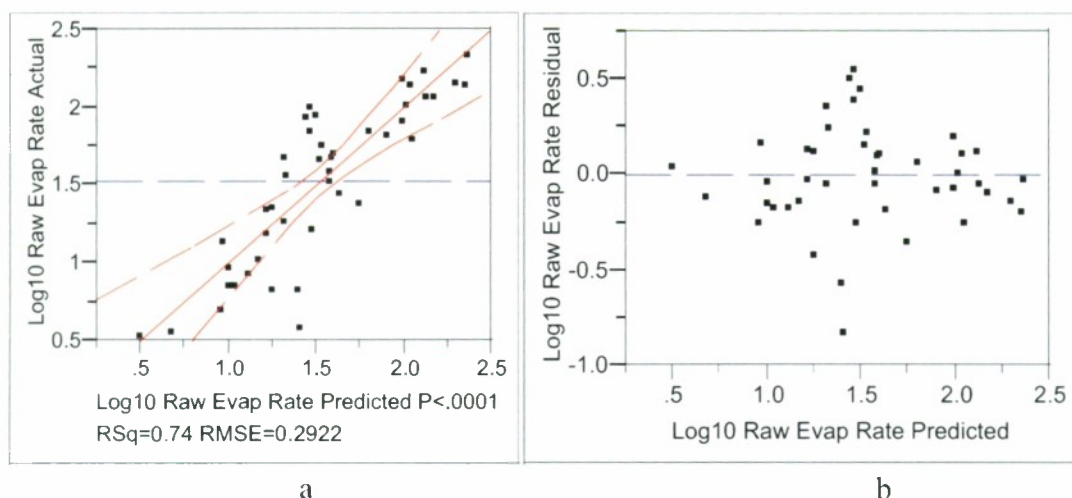


Figure 8. Plot of (a) Actual vs. Predicted Values (dashed lines are the 95% confidence intervals) and (b) Residuals for $\text{Log}_{10}(\text{Raw Evaporation rate})$ ($\mu\text{g}/\text{min}$) of Sulfur Mustard from C04 Concrete.

Once the regression curves for the 44 experiments of munition-grade sulfur mustard had been calculated, the curves were used to predict the evaporation rates of the munition grade sulfur mustard on the rippled surface and CASARM grade sulfur mustard on the molded surface. The predictions thus obtained are shown in Figures 9 and 10. The evaporation rates from the rippled surface using CASARM grade sulfur mustard (HD) fell within the envelope of predictions based on the 44 experiments, suggesting that the identity of the sulfur mustard and the morphology of the surface were not major contributors to the evaporation rate.

In addition, an ANOVA method was used to compare the raw evaporation rates of the agent on the different concrete surfaces and to compare the H versus HD.¹¹ None of the variations in substrate or agent made a statistically significant difference (Figure 11, Table 5).

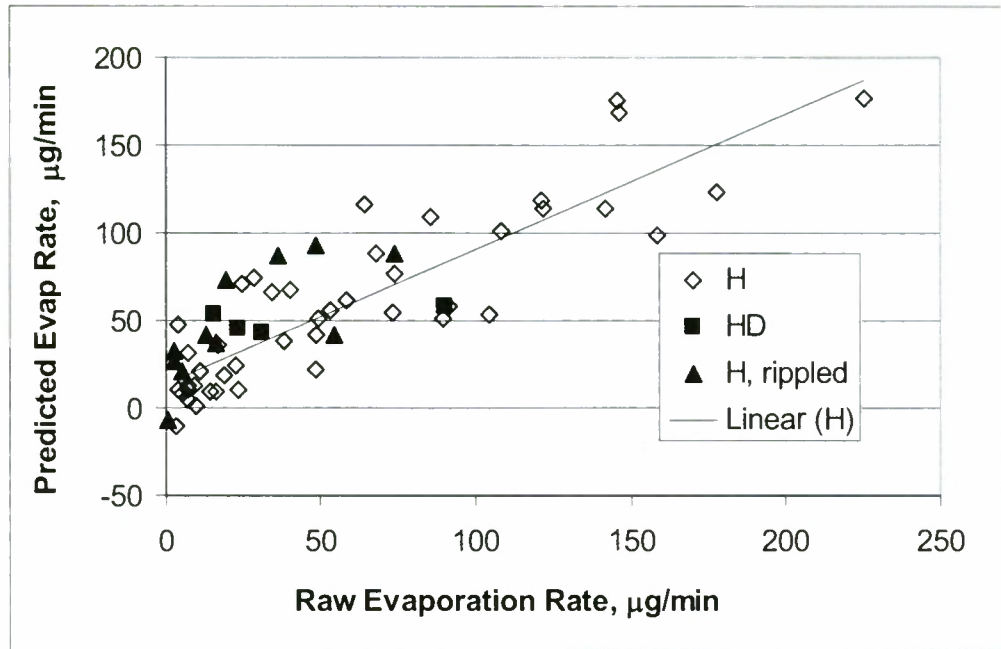


Figure 9. Evaporation of H from Concrete: Comparison of HD on Bottom (■) and H on Rippled Top Surface (▲) to H on Bottom (◇).

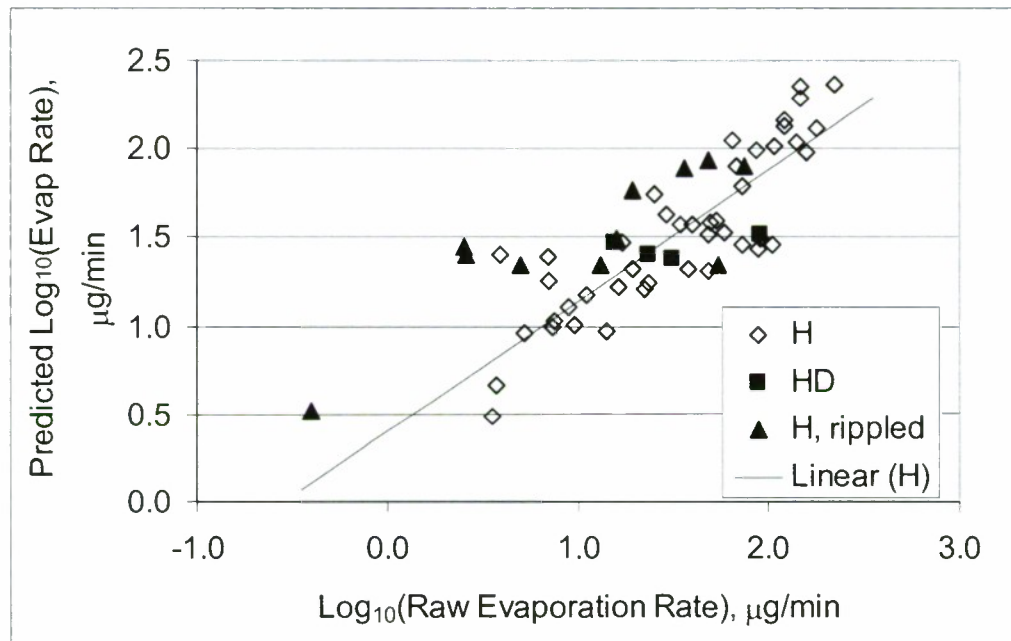


Figure 10. Evaporation of H from Concrete: Comparison of HD on Bottom (■) and H on Rippled Top Surface (▲) to H on Bottom (◇).

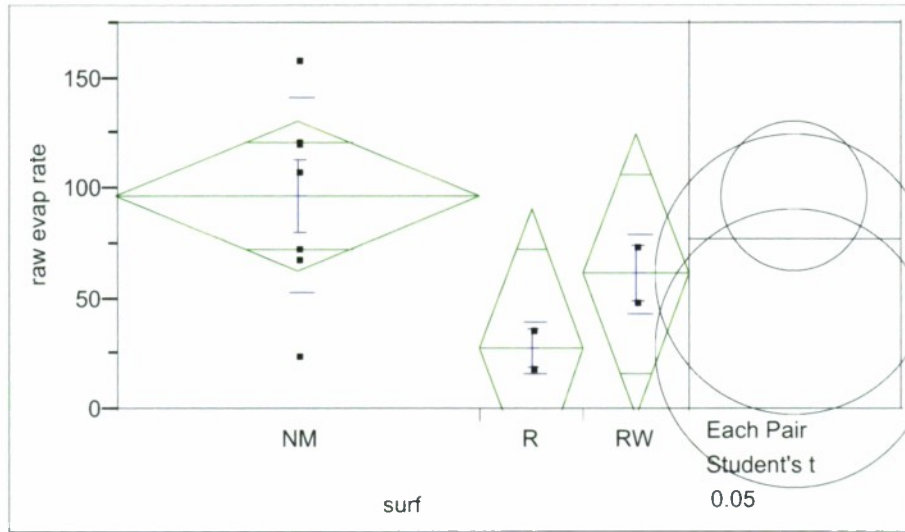


Figure 11. Comparison of H Evaporation from Molded (NM), Rippled (R), and Rippled Weathered (RW) C04 Concrete. Diamonds show mean, upper, and lower 95% confidence intervals. Blue marks show mean and one standard deviation. Circles show overlap of 95% confidence intervals, indicating that none of the means is statistically significantly different.

Table 5. Comparison of Means for One-way ANOVA for Raw Evaporation Rate ($\mu\text{g}/\text{min}$) of H and HD on Concrete Surfaces.

	Surface	Agent	Number	Mean	Std Error [†]	Lower 95%	Upper 95%
50 °C, 9 μL , 18 SLPM							
	NM	H	7	96.6571	14.731	62.69	130.63
	R	H	2	27.7000	27.559	-35.85	91.25
	RW	H	2	61.3500	27.559	-2.20	124.90
50 °C, 1 μL , 18 SLPM							
	NM	H	6	27.3833	6.053	13.07	41.697
	R	H	3	3.3333	8.560	-16.91	23.575
	RW	H	1	15.9000	14.827	-19.16	50.960
35 °C, 7 μL , 181 SLPM [‡]							
	NM	H	10	56.2100	10.183	33.52	78.900
	R	H	2	33.6500	22.770	-17.09	84.386
	NM	H	10	56.2100	10.412	33.525	78.895
	NM	HD	4	40.0500	16.462	4.181	75.919

[†] Std Error used a pooled estimate of error variance.

[‡] One ANOVA was performed to compare NM to R, another compared H with HD.

3.2 Comparison of Glass, Sand, and Concrete

Evaporation profiles of sulfur mustard from glass, sand, and concrete at the same environmental conditions are shown in Figure 12. The evaporation profile on concrete was different from the sand and glass. The rate began higher and increased slowly as the H spread over the surface of the concrete, then decreased quickly as the surface H was exhausted, and the balance of the agent was trapped in the pores of the concrete. By contrast, previous work showed that the evaporation of CASARM sulfur mustard from glass occurred from a sessile droplet with a constant base and the contact angle changing during the evaporation.¹² Previous studies also showed that sulfur mustard absorbed into sand within 0.1 sec¹³ although evaporation from the surface occurred for several hours (Figure 12).

The evaporation rates on the three substrates at different conditions are shown in a cube plot (Figure 13). On all three substrates, the evaporation rate increased with drop mass, temperature, and wind speed. Concrete had the highest evaporation rate in all cases except the high temperature-large drop size-high air flow condition (Figure 13).

The equations that resulted for the evaporation rate and $\log_{10}(\text{evaporation rate})$ of HD from glass¹ were applied to the munition sulfur mustard from UK sand² and concrete wind tunnel measurements (Figures 14 and 15). This comparison was done using the actual mass of sulfur mustard, which corrected the 97% purity of CASARM HD and 77% purity of munition H.

The raw evaporation rates from glass and sand gave straight lines ($r^2 = 0.86$ and 0.87 , respectively); the concrete data had a large degree of scatter ($r^2 = 0.69$). The raw evaporation rates trended higher for the concrete than for the glass and sands. Interestingly, although likely coincidentally, the raw evaporation rate regression lines for the glass and concrete were roughly parallel with an offset. The regression lines for the glass roughly followed the diagonal of the graph, as expected.

Applying the $\log_{10}(\text{evaporation rate})$ derived from glass to glass and sand gave straight lines ($r^2 = 0.91$ and 0.93 , respectively). Although the data were clustered, the concrete data showed more scatter ($r^2 = 0.58$) than the glass and sand data.

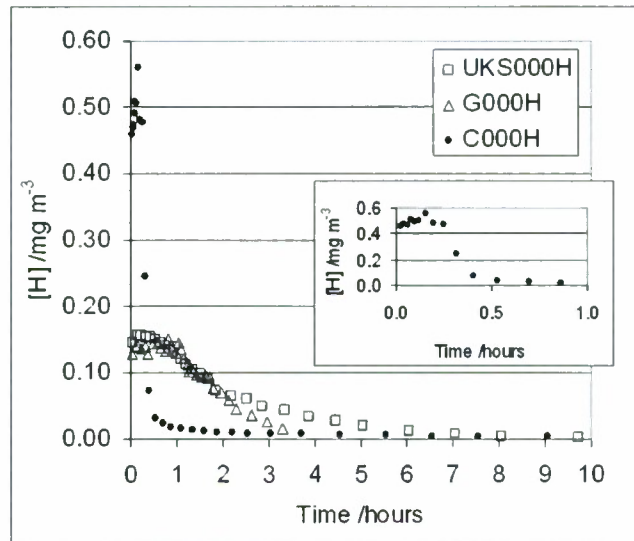


Figure 12. Plot of Vapor Concentration vs. Time for Evaporation of Munition-grade Sulfur Mustard (H) from Glass (Δ), Sand (\square), and Concrete (\bullet) at 35 °C, 6 μ L Drop, 181 SLPM Air Flow. Inset shows evaporation rate profile from concrete in more detail.

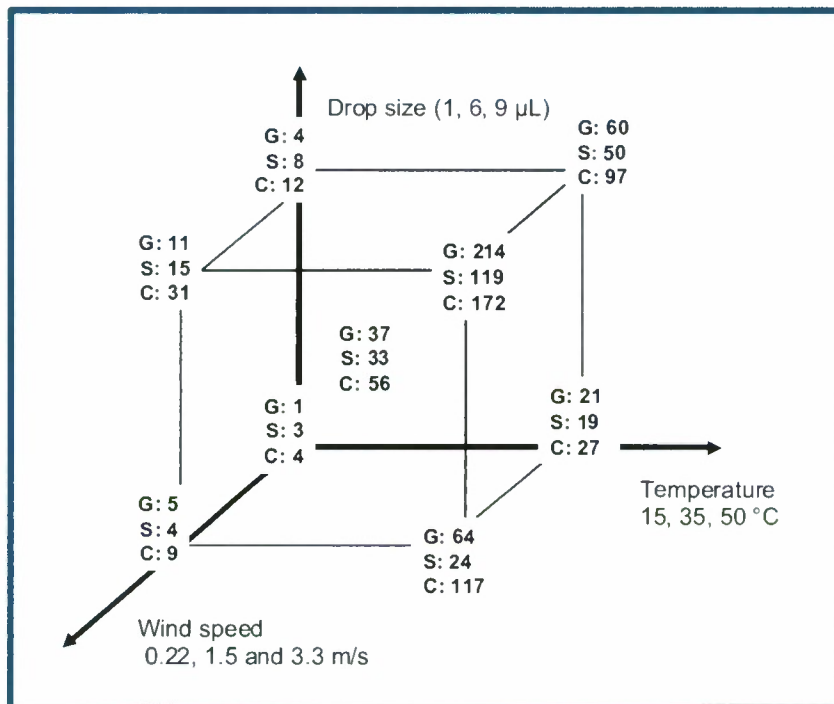


Figure 13. Cube Plot Showing Average Evaporation Rates (μ g/min) of HD from Glass (G), and H from Sand (S) and Concrete (C).

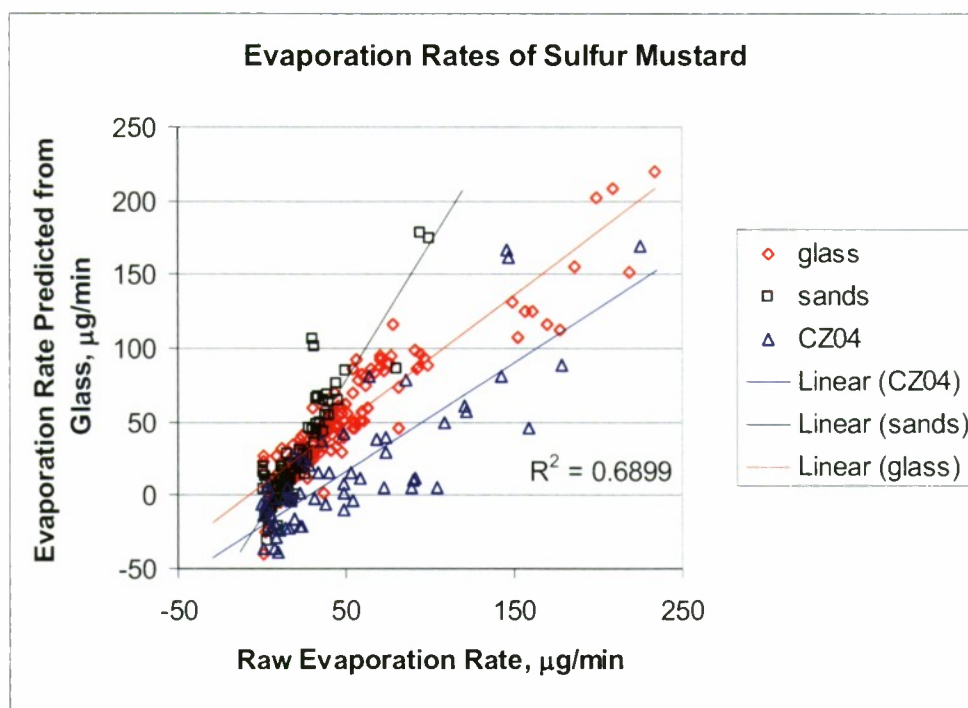


Figure 14. Prediction of Evaporation Rates of Sulfur Mustard: HD from Glass (\diamond), H from Sands (\square), and H from Concrete (\triangle) Using Equation Derived for Glass.

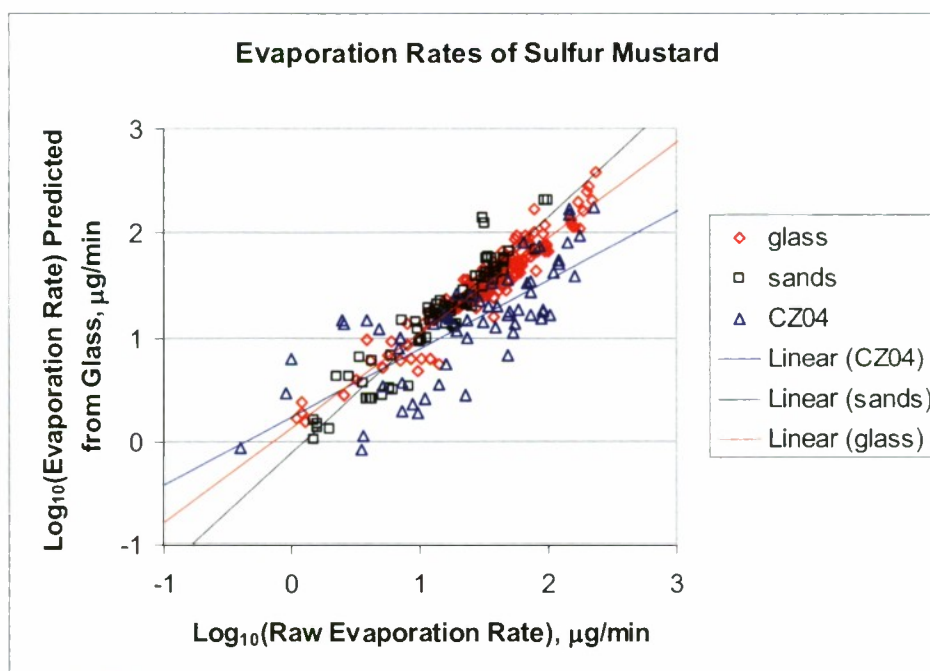


Figure 15. Prediction of $\text{Log}_{10}(\text{Evaporation Rates})$ of Sulfur Mustard: HD from Glass (\diamond), H from Sands (\square), and H from Concrete (\triangle) Using Equation Derived for Glass.

3.3 Recommendations for Future Projects

The following recommendations were determined for future projects:

- Gauge the effect of variations in porous substrates from diverse sources by measuring agent evaporation rates and the percentage agent evaporated at one condition.
- Measure the agent vapor concentrations after rain events.
- Determine the long-term scenarios in which the entrained agent will be mobilized from or transported within the porous substrate after the secondary evaporation event.
- Thoroughly analyze all prior agent evaporation studies and models, and compare data to models to indicate where gaps in the experimental data reside.

4. CONCLUSIONS

The evaporation rate of HD from glass and H from sand and concrete rose with increasing temperature, drop size, and wind speed. The evaporation rates for the concrete exhibited a greater degree of scatter than the rates from glass and sand, likely due to the variability in the morphology of the concrete. The generic response of the evaporation rate to the environmental conditions was common to all three substrates although the magnitude of the response, the evaporation profiles, and the mechanisms of evaporation (from a sessile droplet on glass, from a subsurface pool of agent on sand, and from a droplet that spread on the surface and then adsorbed on concrete) differed. The percentage of agent that remained in the substrate also differed – 0%, 89% and 67% on glass, sand, and concrete, respectively.

Blank

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¹³ Navaz, H.K.; Markicevic, B.; Zand, A.R.; Sikorski, Y.; Chan, E.; Sanders, M.; D'Onofrio, T.G. Sessile Droplet Spread into Porous Substrates – Determination of Capillary Pressure Using a Continuum Approach. *J. Colloid Interface Science* **2008**, (325), 440-446.

APPENDIX A

NITROGEN GAS ADSORPTION DATA
FOR CONCRETE C04



Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

Page 1

Sample: CZ2004 Q3
Operator: AT
Submitter: SAIC
File: C:\2420\2007\10OCT\07-4316.SMP

Started: 10/26/2007 3:36:45PM
Completed: 10/27/2007 2:12:52AM
Report Time: 10/30/2007 9:27:00AM
Sample Mass: 0.5100 g
Cold Free Space: 86.7000 cm³
Low Pressure Dose: 0.200 cm³/g STP

Analysis Adsorptive: N₂
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No

Summary Report

Surface Area

Single point surface area at P/Po = 0.150290697: 2.2338 m²/g

BET Surface Area: 2.2728 m²/g

t-Plot Micropore Area: 1.3972 m²/g

t-Plot External Surface Area: 0.8756 m²/g

BJH Adsorption cumulative surface area of pores
between 17.000 Å and 3000.000 Å diameter: 1.513 m²/g

Pore Volume

Single point adsorption total pore volume of pores
less than 3615.424 Å diameter at P/Po = 0.994640050: 0.014140 cm³/g

Single point desorption total pore volume of pores
less than 1082.786 Å diameter at P/Po = 0.981787878: 0.013532 cm³/g

t-Plot micropore volume: 0.000601 cm³/g

BJH Adsorption cumulative volume of pores
between 17.000 Å and 3000.000 Å diameter: 0.011792 cm³/g

Pore Size

Adsorption average pore width (4V/A by BET): 248.8576 Å

Desorption average pore width (4V/A by BET): 238.1505 Å

BJH Adsorption average pore diameter (4V/A): 311.809 Å

DFT Pore Size

Volume in Pores	<	10.22 Å	:	0.00001 cm ³ /g
Total Volume in Pores	<=	117.82 Å	:	0.00140 cm ³ /g
Area in Pores	>	117.82 Å	:	0.160 m ² /g
Total Area in Pores	>=	10.22 Å	:	2.115 m ² /g

Horvath-Kawazoe

Maximum pore volume at P/Po = 0.319748901: 0.001053 cm³/g

Median pore width: 9.021 Å



Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

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Page 2

Sample: CZ2004 Q3
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Report Time: 10/30/2007 9:27:00AM
Sample Mass: 0.5100 g
Cold Free Space: 86.7000 cm³
Low Pressure Dose: 0.200 cm³/g STP

Analysis Adsorptive: N2
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No

Isotherm Tabular Report

Relative Pressure (P/Po)	Absolute Pressure (mmHg)	Quantity Adsorbed (cm ³ /g STP)	Elapsed Time (h:min)	Saturation Pressure (mmHg)
0.000077150	0.057006	0.1427	00:39	738.543823
0.000523889	0.387155	0.2241	01:14	738.891174
0.001177411	0.870213	0.2652	01:33	739.001404
0.001871653	1.383072	0.2908	01:51	739.090820
0.002610180	1.929309	0.3101	02:06	738.957764
0.003339327	2.468362	0.3249	02:25	739.148071
0.004162060	3.076664	0.3387	02:43	739.179260
0.005002587	3.697522	0.3507	03:00	739.216675
0.005857506	4.329813	0.3613	03:05	739.122070
0.009532030	73.694046	0.5687	03:15	739.190674
0.120304106	89.075050	0.5849	06:50	740.405334
0.150290697	111.279465	0.6039	06:54	740.415710
0.180245947	133.467239	0.6198	06:58	740.428162
0.210153162	155.618622	0.6370	07:01	740.472900
0.240098620	177.802246	0.6476	07:05	740.500977
0.270032237	199.969238	0.6594	07:09	740.538391
0.319748901	236.779037	0.6809	07:12	740.538391
0.339824118	251.645401	0.6877	07:16	740.515564
0.359734064	266.403625	0.6941	07:20	740.516602
0.399817499	296.082306	0.7098	07:24	740.557129
0.439751643	325.658020	0.7278	07:27	740.543640
0.479719212	355.253510	0.7457	07:31	740.549866
0.519635728	384.845886	0.7668	07:35	740.544678
0.559611529	414.447601	0.7953	07:38	740.607056
0.579892856	429.493835	0.8100	07:42	740.598755
0.619842071	459.085175	0.8490	07:46	740.643433
0.659815967	488.691101	0.8972	07:50	740.648621
0.699808230	518.315674	0.9587	07:53	740.647583
0.739797578	547.924683	1.0422	07:57	740.653870
0.779763949	577.536804	1.1497	08:01	740.641357
0.819536684	607.068848	1.3071	08:05	740.655945
0.859553077	636.702820	1.5437	08:08	740.746399
0.889402491	658.768982	1.8500	08:12	740.737061
0.900048274	666.628906	2.0088	08:16	740.687134
0.909894330	673.881714	2.1758	08:20	740.659058
0.919669773	681.091919	2.3838	08:23	740.615356
0.929608069	688.400818	2.6536	08:27	740.583130
0.939381289	695.656738	2.9980	08:31	740.528015
0.949266795	702.983337	3.4449	08:36	740.547791
0.954657364	706.879028	3.7742	08:42	740.554016
0.959754579	710.684265	4.1147	08:44	740.453125
0.964481387	714.143250	4.4572	08:52	740.485413
0.969242588	717.630371	4.8874	08:57	740.442749
0.974387641	721.440796	5.4006	09:03	740.403259
0.979136540	724.904968	5.9599	09:10	740.404297
			09:17	740.351257



Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

Page 3

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Submitter: SAIC
File: C:\2420\2007\10OCT\07-4316.SMP

Started: 10/26/2007 3:36:45PM	Analysis Adsorptive: N2
Completed: 10/27/2007 2:12:52AM	Analysis Bath Temp.: 77.300 K
Report Time: 10/30/2007 9:27:00AM	Thermal Correction: No
Sample Mass: 0.5100 g	Warm Free Space: 28.2500 cm ³ Entered
Cold Free Space: 86.7000 cm ³	Equilibration Interval: 20 s
Low Pressure Dose: 0.200 cm ³ /g STP	Automatic Degas: No

Isotherm Tabular Report

Relative Pressure (P/Po)	Absolute Pressure (mmHg)	Quantity Adsorbed (cm ³ /g STP)	Elapsed Time (h:min)	Saturation Pressure (mmHg)
0.981626972	726.829407	6.3596	09:23	740.433411
0.984351205	728.917114	6.8376	09:29	740.505127
0.987128551	730.908081	7.3087	09:36	740.438599
0.989188851	732.563232	7.7667	09:42	740.569641
0.991556981	734.293274	8.2802	09:50	740.545715
0.993496206	735.615723	8.7742	09:57	740.431335
0.994640050	736.578491	9.1416	10:02	740.547791
0.997107754	738.279419	9.8941	10:13	740.420898
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Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

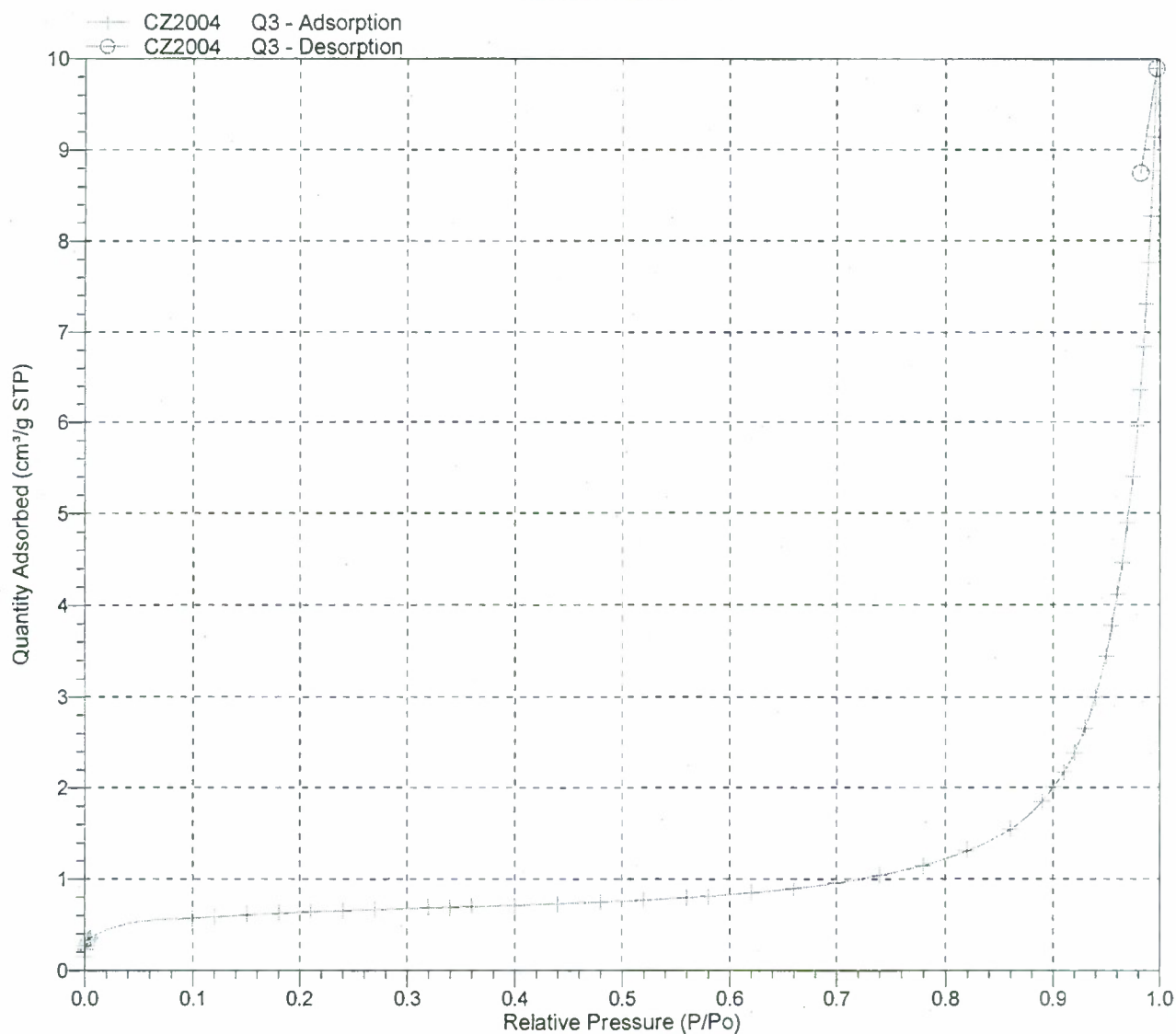
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Analysis Adsorptive: N2
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No

Isotherm Linear Plot





Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

Page 5

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Operator: AT
Submitter: SAIC
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Completed: 10/27/2007 2:12:52AM	Analysis Bath Temp.: 77.300 K
Report Time: 10/30/2007 9:27:00AM	Thermal Correction: No
Sample Mass: 0.5100 g	Warm Free Space: 28.2500 cm ³ Entered
Cold Free Space: 86.7000 cm ³	Equilibration Interval: 20 s
Low Pressure Dose: 0.200 cm ³ /g STP	Automatic Degas: No

BET Surface Area Report

BET Surface Area: 2.2728 ± 0.0112 m²/g
Slope: 1.910566 ± 0.009396 g/cm³ STP
Y-Intercept: 0.004753 ± 0.001018 g/cm³ STP
C: 402.963269
Qm: 0.5221 cm³/g STP
Correlation Coefficient: 0.9999758
Molecular Cross-Sectional Area: 0.1620 nm²

Relative Pressure (P/Po)	Quantity Adsorbed (cm ³ /g STP)	1/[Q(Po/P - 1)]
0.005857506	0.3613	0.016306
0.099532030	0.5687	0.194357
0.120304106	0.5849	0.233808
0.150290697	0.6039	0.292886



Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

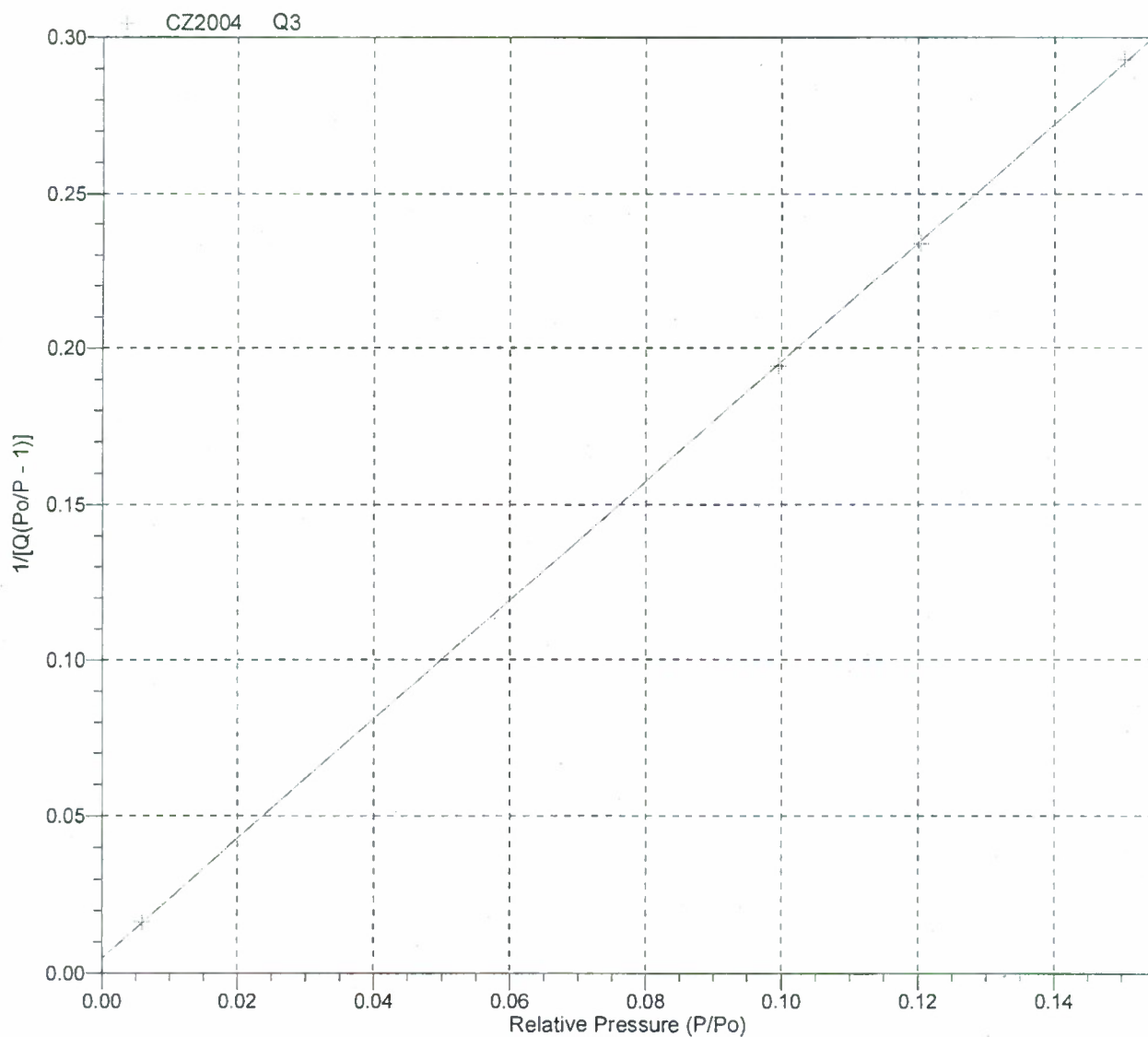
Page 6

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Report Time: 10/30/2007 9:27:00AM
Sample Mass: 0.5100 g
Cold Free Space: 86.7000 cm³
Low Pressure Dose: 0.200 cm³/g STP

Analysis Adsorptive: N2
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No

BET Surface Area Plot





Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

Page 7

Sample: CZ2004 Q3
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Report Time: 10/30/2007 9:27:00AM
Sample Mass: 0.5100 g
Cold Free Space: 86.7000 cm³
Low Pressure Dose: 0.200 cm³/g STP

Analysis Adsorptive: N2
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No

t-Plot Report

Micropore Volume: 0.000601 cm³/g
Micropore Area: 1.3972 m²/g
External Surface Area: 0.8756 m²/g
Slope: 0.056610 ± 0.000936 cm³/g·Å STP
Y-Intercept: 0.388819 ± 0.005285 cm³/g STP
Correlation Coefficient: 0.999454
Surface Area Correction Factor: 1.000
Density Conversion Factor: 0.0015468
Total Surface Area (BET): 2.2728 m²/g
Thickness Range: 5.0000 Å to 6.5000 Å
Thickness Equation: Harkins and Jura
$$t = [13.99 / (0.034 - \log(P/P_o))] ^{0.5}$$

Relative Pressure (P/P _o)	Statistical Thickness (Å)	Quantity Adsorbed (cm ³ /g STP)
0.000077150	1.8368	0.1427
0.000523889	2.0544	0.2241
0.001177411	2.1729	0.2652
0.001871653	2.2507	0.2908
0.002610180	2.3120	0.3101
0.003339327	2.3607	0.3249
0.004162060	2.4070	0.3387
0.005002587	2.4478	0.3507
0.005857506	2.4846	0.3613
0.009532030	3.6747	0.5687
0.120304106	3.8300	0.5849
0.150290697	4.0402	0.6039
0.180245947	4.2402	0.6198
0.210153162	4.4344	0.6370
0.240098620	4.6265	0.6476
0.270032237	4.8184	0.6594
0.319748901	5.1417	0.6809
0.339824118	5.2751	0.6877
0.359734064	5.4099	0.6941
0.399817499	5.6898	0.7098
0.439751643	5.9832	0.7278
0.479719212	6.2953	0.7457
0.519635728	6.6296	0.7668
0.559611529	6.9926	0.7953
0.579892856	7.1896	0.8100
0.619842071	7.6077	0.8490
0.659815967	8.0745	0.8972
0.699808230	8.6031	0.9587
0.739797578	9.2112	1.0422
0.779763949	9.9245	1.1497
0.819536684	10.7780	1.3071
0.859553077	11.8441	1.5437



Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

Page 8

Sample: CZ2004 Q3
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Analysis Adsorptive: N2
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No

Relative Pressure (P/Po)	Statistical Thickness (Å)	Quantity Adsorbed (cm ³ /g STP)
0.889402491	12.8366	1.8500
0.900048274	13.2461	2.0088
0.909894330	13.6569	2.1758
0.919669773	14.1001	2.3838
0.929608069	14.5924	2.6536
0.939381289	15.1245	2.9980
0.949266795	15.7201	3.4449
0.954657364	16.0731	3.7742
0.959754579	16.4277	4.1147
0.964481387	16.7766	4.4572
0.969242588	17.1496	4.8874
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0.979136540	18.0046	5.9599
0.981626972	18.2393	6.3596
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0.987128551	18.7896	7.3087
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0.993496206	19.4888	8.7742
0.994640050	19.6224	9.1416
0.997107754	19.9196	9.8941



Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

Page 9

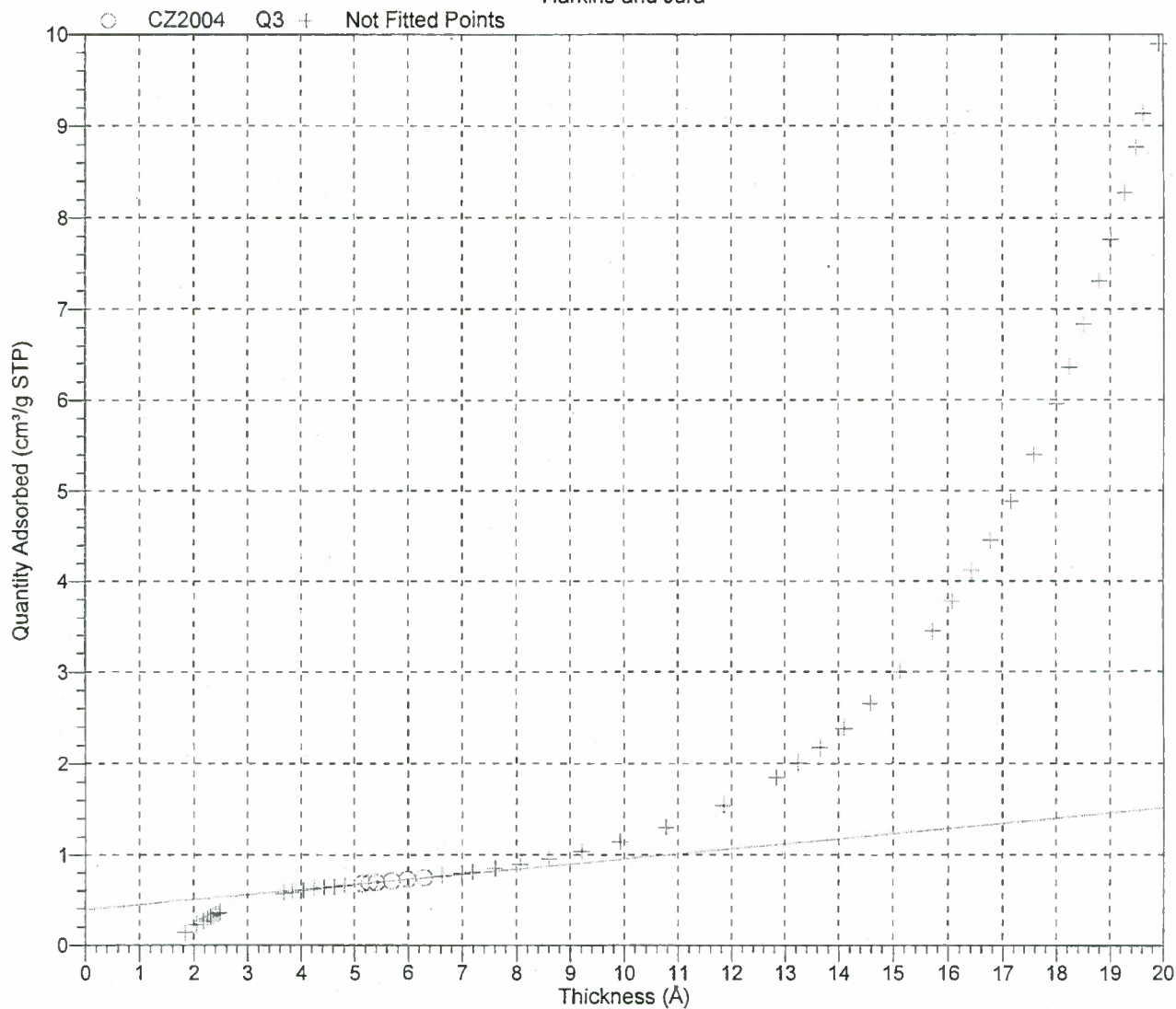
Sample: CZ2004 Q3
Operator: AT
Submitter: SAIC
File: C:\2420\2007\10OCT\07-4316.SMP

Started: 10/26/2007 3:36:45PM
Completed: 10/27/2007 2:12:52AM
Report Time: 10/30/2007 9:27:00AM
Sample Mass: 0.5100 g
Cold Free Space: 86.7000 cm³
Low Pressure Dose: 0.200 cm³/g STP

Analysis Adsorptive: N2
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No

t-Plot

Harkins and Jura





Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

Page 10

Sample: CZ2004 Q3
Operator: AT
Submitter: SAIC
File: C:\2420\2007\10OCT\07-4316.SMP

Started: 10/26/2007 3:36:45PM
Completed: 10/27/2007 2:12:52AM
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Analysis Adsorptive: N2
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No

Porosity Distribution by Density Functional Theory
Model: N2 @ 77K, Cylindrical Pores in an Oxide Surface
Method: Non-negative Regularization; No Smoothing

Volume in Pores	<	10.22 Å	:	0.00001 cm ³ /g
Total Volume in Pores	<=	117.82 Å	:	0.00140 cm ³ /g
Area in Pores	>	117.82 Å	:	0.160 m ² /g
Total Area in Pores	>=	10.22 Å	:	2.115 m ² /g

Pore Size Table

Pore Width (Å)	Cumulative Volume (cm ³ /g)	Incremental Volume (cm ³ /g)	Cumulative Area (m ² /g)	Incremental Area (m ² /g)
10.22	0.00000	0.00000	0.000	0.000
10.58	0.00000	0.00000	0.000	0.000
10.94	0.00000	0.00000	0.000	0.000
11.30	0.00000	0.00000	0.000	0.000
11.65	0.00000	0.00000	0.000	0.000
12.01	0.00002	0.00002	0.052	0.052
12.37	0.00002	0.00000	0.052	0.000
12.73	0.00002	0.00000	0.052	0.000
13.08	0.00002	0.00000	0.052	0.000
13.44	0.00002	0.00000	0.052	0.000
13.80	0.00004	0.00003	0.133	0.080
14.16	0.00007	0.00003	0.213	0.080
14.51	0.00007	0.00000	0.213	0.000
14.87	0.00007	0.00000	0.213	0.000
15.23	0.00007	0.00000	0.213	0.000
15.59	0.00007	0.00000	0.213	0.000
15.94	0.00007	0.00000	0.213	0.000
16.30	0.00041	0.00033	1.031	0.819
16.66	0.00041	0.00000	1.031	0.000
17.02	0.00044	0.00003	1.111	0.080
17.37	0.00044	0.00000	1.111	0.000
17.73	0.00044	0.00000	1.111	0.000
18.09	0.00044	0.00000	1.111	0.000
18.44	0.00067	0.00023	1.606	0.495
18.80	0.00067	0.00000	1.606	0.000
19.16	0.00067	0.00000	1.606	0.000
19.52	0.00067	0.00000	1.606	0.000
19.87	0.00067	0.00000	1.606	0.000
20.23	0.00067	0.00000	1.606	0.000
20.59	0.00067	0.00000	1.606	0.000
20.95	0.00067	0.00000	1.606	0.000
21.30	0.00067	0.00000	1.606	0.000
21.66	0.00067	0.00000	1.606	0.000
22.38	0.00067	0.00000	1.606	0.000
23.09	0.00067	0.00000	1.606	0.000
23.81	0.00067	0.00000	1.606	0.000
24.52	0.00067	0.00000	1.606	0.000



Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

Page 11

Sample: CZ2004 Q3
Operator: AT
Submitter: SAIC
File: C:\2420\2007\10OCT\07-4316.SMP

Started: 10/26/2007 3:36:45PM
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Low Pressure Dose: 0.200 cm³/g STP

Analysis Adsorptive: N2
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No

Pore Size Table				
Pore Width (Å)	Cumulative Volume (cm ³ /g)	Incremental Volume (cm ³ /g)	Cumulative Area (m ² /g)	Incremental Area (m ² /g)
25.24	0.00067	0.00000	1.610	0.004
25.95	0.00067	0.00000	1.610	0.000
26.67	0.00067	0.00000	1.610	0.000
27.38	0.00067	0.00000	1.610	0.000
28.10	0.00068	0.00001	1.618	0.009
28.81	0.00068	0.00000	1.618	0.000
29.53	0.00068	0.00000	1.618	0.000
30.24	0.00068	0.00000	1.618	0.000
30.96	0.00068	0.00000	1.618	0.000
31.67	0.00068	0.00000	1.618	0.000
32.39	0.00068	0.00000	1.618	0.000
33.10	0.00068	0.00000	1.618	0.000
33.82	0.00068	0.00000	1.618	0.000
34.53	0.00068	0.00000	1.618	0.000
35.25	0.00068	0.00000	1.618	0.000
35.96	0.00068	0.00000	1.618	0.000
36.68	0.00068	0.00000	1.618	0.000
37.39	0.00068	0.00000	1.618	0.000
38.11	0.00068	0.00000	1.618	0.000
38.82	0.00068	0.00000	1.618	0.000
39.54	0.00068	0.00000	1.618	0.000
40.25	0.00068	0.00000	1.618	0.000
40.96	0.00068	0.00000	1.618	0.000
41.68	0.00068	0.00000	1.618	0.000
42.39	0.00068	0.00000	1.618	0.000
43.11	0.00068	0.00000	1.618	0.000
43.82	0.00068	0.00000	1.618	0.000
44.54	0.00068	0.00000	1.618	0.000
45.25	0.00068	0.00000	1.620	0.002
45.97	0.00068	0.00000	1.620	0.000
46.68	0.00068	0.00000	1.623	0.003
47.40	0.00068	0.00000	1.623	0.000
48.11	0.00068	0.00000	1.623	0.000
48.83	0.00069	0.00000	1.626	0.003
49.54	0.00069	0.00000	1.626	0.000
50.26	0.00069	0.00000	1.629	0.002
52.05	0.00069	0.00001	1.633	0.005
54.91	0.00071	0.00002	1.645	0.012
57.77	0.00073	0.00002	1.656	0.011
60.98	0.00075	0.00002	1.670	0.014
64.20	0.00077	0.00002	1.684	0.014
67.42	0.00081	0.00004	1.707	0.022
70.99	0.00085	0.00004	1.730	0.024
74.57	0.00088	0.00003	1.747	0.016
78.50	0.00093	0.00005	1.772	0.025
82.79	0.00098	0.00005	1.798	0.026



Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

Page 12

Sample: CZ2004 Q3
Operator: AT
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File: C:\2420\2007\10OCT\07-4316.SMP

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Analysis Adsorptive: N2
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No

Pore Size Table

Pore Width (Å)	Cumulative Volume (cm ³ /g)	Incremental Volume (cm ³ /g)	Cumulative Area (m ² /g)	Incremental Area (m ² /g)
87.08	0.00102	0.00004	1.816	0.018
91.37	0.00107	0.00004	1.834	0.018
96.37	0.00113	0.00007	1.863	0.029
101.38	0.00122	0.00008	1.896	0.033
106.38	0.00127	0.00006	1.917	0.022
112.10	0.00133	0.00005	1.937	0.019
117.82	0.00138	0.00005	1.954	0.018



Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

Page 13

Sample: CZ2004 Q3
Operator: AT
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Analysis Adsorptive: N2
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No

Porosity Distribution by Density Functional Theory
Model: N2 @ 77K, Cylindrical Pores in an Oxide Surface
Method: Non-negative Regularization; No Smoothing

Standard Deviation of Fit: 0.00302, cm³/g STP

Relative Pressure	Isotherm Table		Absolute Residual (cm ³ /g STP)	Relative Residual
	Experimental Quantity Adsorbed (cm ³ /g STP)	Fitted Quantity Adsorbed (cm ³ /g STP)		
0.000079433	0.1432	0.1372	0.0060	0.042105
0.000100000	0.1482	0.1462	0.0020	0.013191
0.000125892	0.1544	0.1556	-0.0012	-0.007915
0.000158490	0.1620	0.1652	-0.0033	-0.020140
0.000199526	0.1712	0.1754	-0.0042	-0.024477
0.000251188	0.1824	0.1861	-0.0038	-0.020695
0.000316228	0.1952	0.1970	-0.0018	-0.009095
0.000398107	0.2091	0.2080	0.0011	0.005191
0.000501187	0.2221	0.2194	0.0027	0.012214
0.000630958	0.2328	0.2312	0.0016	0.006858
0.000794328	0.2447	0.2439	0.0008	0.003307
0.001000000	0.2571	0.2560	0.0010	0.004047
0.001258925	0.2684	0.2683	0.0001	0.000328
0.001584895	0.2812	0.2808	0.0004	0.001281
0.001995263	0.2942	0.2937	0.0006	0.001999
0.002511882	0.3079	0.3067	0.0011	0.003698
0.003162276	0.3216	0.3201	0.0015	0.004617
0.003981066	0.3359	0.3338	0.0020	0.006000
0.005011868	0.3509	0.3479	0.0030	0.008485
0.006309579	0.3643	0.3623	0.0020	0.005393
0.007943276	0.3748	0.3773	-0.0026	-0.006821
0.010000000	0.3874	0.3929	-0.0055	-0.014257
0.012355640	0.4010	0.4076	-0.0066	-0.016388
0.015186320	0.4163	0.4224	-0.0060	-0.014504
0.018485530	0.4328	0.4369	-0.0041	-0.009428
0.022294740	0.4501	0.4527	-0.0026	-0.005748
0.026653420	0.4676	0.4674	0.0002	0.000425
0.031598160	0.4849	0.4805	0.0044	0.009131
0.037162240	0.5013	0.4926	0.0087	0.017368
0.043374470	0.5162	0.5136	0.0027	0.005175
0.050259210	0.5291	0.5256	0.0035	0.006668
0.057835260	0.5397	0.5361	0.0036	0.006759
0.066115920	0.5479	0.5455	0.0024	0.004354
0.075109080	0.5542	0.5542	-0.0001	-0.000160
0.084815920	0.5595	0.5624	-0.0029	-0.005192
0.095232370	0.5656	0.5700	-0.0044	-0.007839
0.106348200	0.5743	0.5773	-0.0030	-0.005261
0.118147500	0.5835	0.5846	-0.0011	-0.001900
0.130609100	0.5917	0.5920	-0.0003	-0.000569



Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

Page 14

Sample: CZ2004 Q3
Operator: AT
Submitter: SAIC
File: C:\2420\2007\10OCT\07-4316.SMP

Started: 10/26/2007 3:36:45PM
Completed: 10/27/2007 2:12:52AM
Report Time: 10/30/2007 9:27:00AM
Sample Mass: 0.5100 g
Cold Free Space: 86.7000 cm³
Low Pressure Dose: 0.200 cm³/g STP

Analysis Adsorptive: N2
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No

Isotherm Table				
Relative Pressure	Experimental Quantity Adsorbed (cm ³ /g STP)	Fitted Quantity Adsorbed (cm ³ /g STP)	Absolute Residual (cm ³ /g STP)	Relative Residual
0.143706600	0.6001	0.5999	0.0002	0.000318
0.157410500	0.6078	0.6075	0.0003	0.000427
0.171685500	0.6152	0.6150	0.0002	0.000307
0.186492100	0.6234	0.6232	0.0002	0.000291
0.201792100	0.6327	0.6305	0.0022	0.003481
0.217539500	0.6400	0.6377	0.0023	0.003636
0.233689500	0.6453	0.6448	0.0005	0.000808
0.250196100	0.6516	0.6519	-0.0003	-0.000534
0.267011800	0.6582	0.6589	-0.0007	-0.001112
0.284089500	0.6654	0.6659	-0.0004	-0.000659
0.301380300	0.6732	0.6728	0.0004	0.000668
0.318838200	0.6805	0.6796	0.0009	0.001272
0.336417100	0.6866	0.6865	0.0001	0.000205
0.354071100	0.6923	0.6933	-0.0010	-0.001424
0.371757900	0.6984	0.7000	-0.0017	-0.002365
0.389435500	0.7053	0.7068	-0.0015	-0.002146
0.407065800	0.7131	0.7136	-0.0006	-0.000794
0.424610500	0.7210	0.7209	0.0001	0.000113
0.442034200	0.7288	0.7287	0.0001	0.000140
0.459305300	0.7366	0.7365	0.0001	0.000080
0.476393400	0.7442	0.7442	0.0001	0.000086
0.493271100	0.7520	0.7527	-0.0008	-0.001037
0.509911800	0.7607	0.7598	0.0009	0.001157
0.526293400	0.7714	0.7714	0.0001	0.000089
0.542394700	0.7829	0.7828	0.0001	0.000080
0.558200000	0.7943	0.7963	-0.0020	-0.002556
0.573690800	0.8055	0.8033	0.0021	0.002621
0.588853900	0.8174	0.8173	0.0000	0.000048
0.603677600	0.8318	0.8360	-0.0043	-0.005130
0.618153900	0.8472	0.8428	0.0044	0.005144
0.632272400	0.8630	0.8629	0.0000	0.000029
0.646028900	0.8796	0.8796	0.0000	0.000026
0.659417100	0.8967	0.9025	-0.0058	-0.006471
0.672435500	0.9147	0.9088	0.0059	0.006433
0.685081600	0.9341	0.9341	0.0000	0.000012
0.697355300	0.9544	0.9544	0.0000	0.000010
0.709256600	0.9754	0.9754	0.0000	0.000010
0.720789500	0.9976	1.0071	-0.0094	-0.009443
0.731953900	1.0223	1.0128	0.0095	0.009301
0.742756600	1.0501	1.0501	0.0000	0.000000
0.753200000	1.0782	1.0782	-0.0000	-0.000000
0.763289500	1.1054	1.1054	-0.0000	-0.000000
0.773030300	1.1316	1.1316	-0.0000	-0.000000



Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

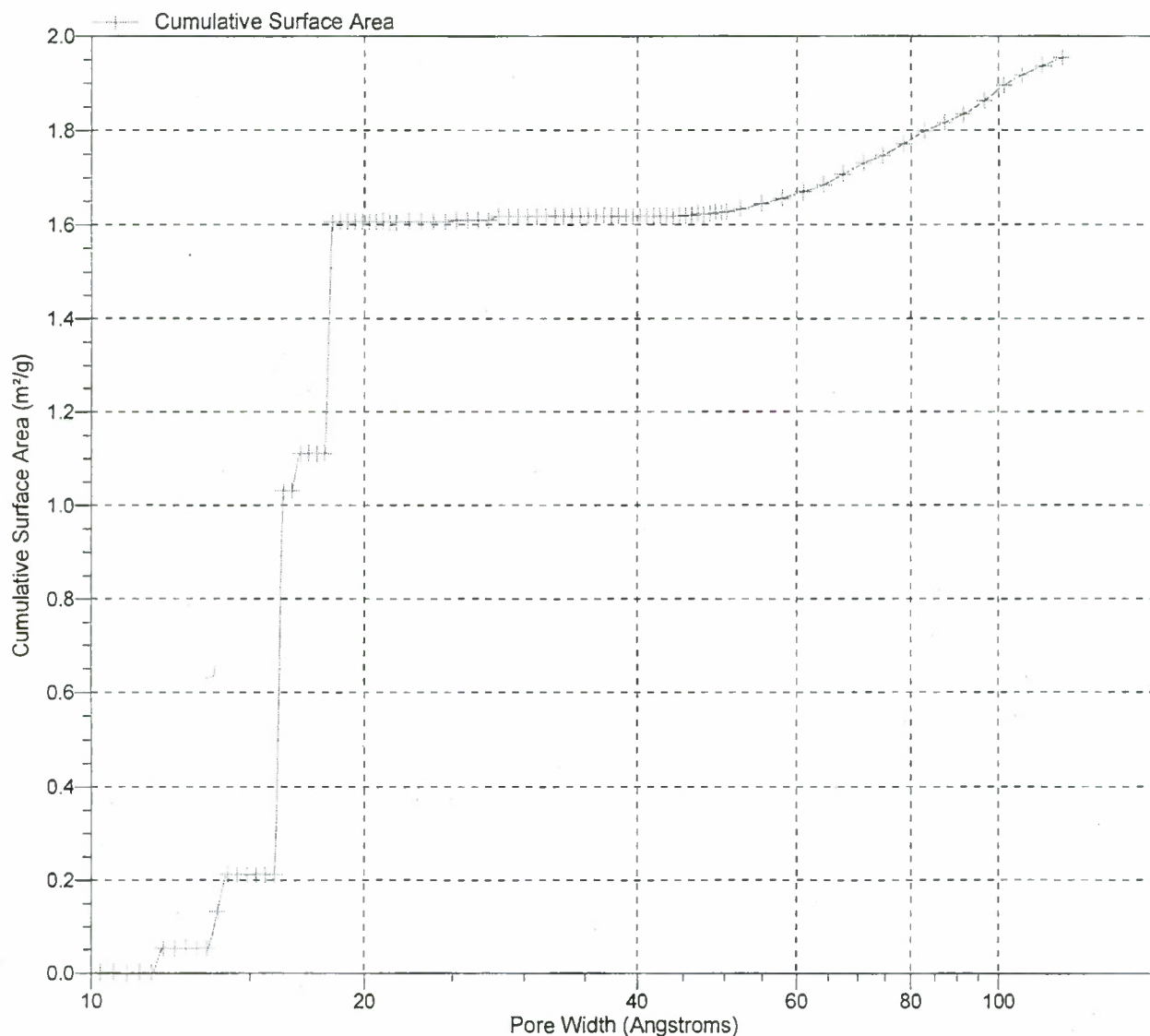
Page 15

Sample: CZ2004 Q3
Operator: AT
Submitter: SAIC
File: C:\2420\2007\10OCT\07-4316.SMP

Started: 10/26/2007 3:36:45PM
Completed: 10/27/2007 2:12:52AM
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Sample Mass: 0.5100 g
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Analysis Adsorptive: N2
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No

Cumulative Surface Area vs. Pore Width





Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

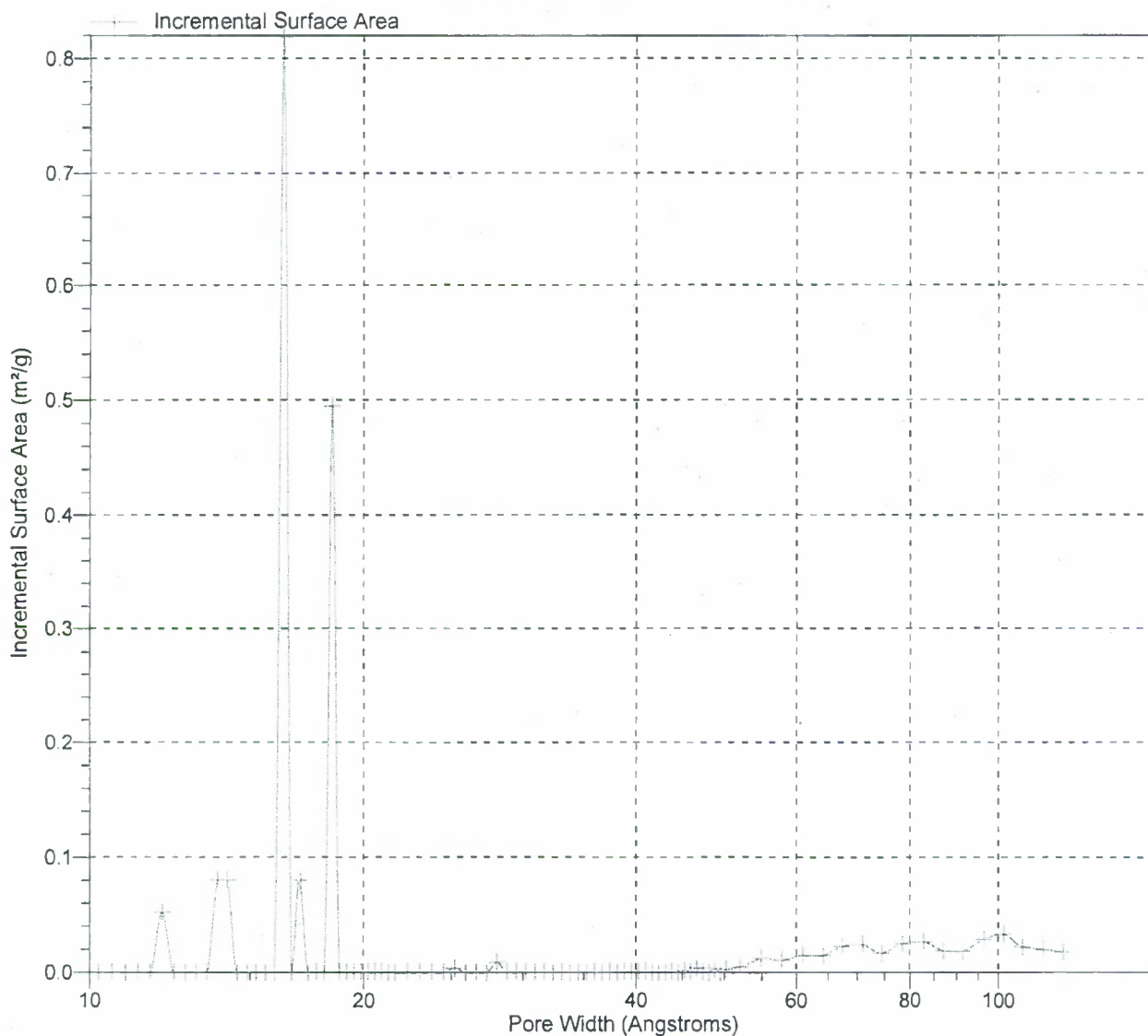
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Sample: CZ2004 Q3
Operator: AT
Submitter: SAIC
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Thermal Correction: No
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Equilibration Interval: 20 s
Automatic Degas: No

Incremental Surface Area vs. Pore Width





Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

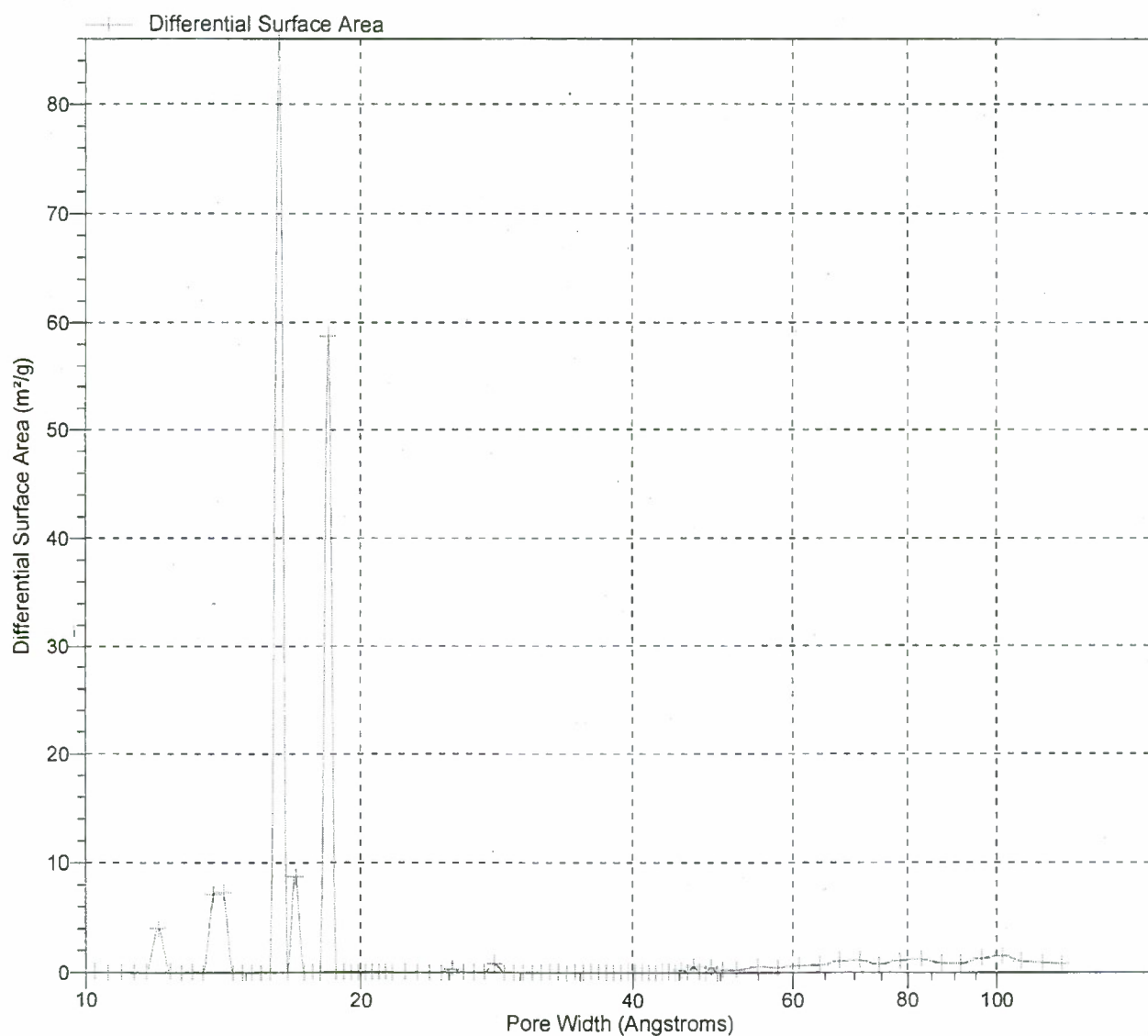
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Sample: CZ2004 Q3
Operator: AT
Submitter: SAIC
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Analysis Adsorptive: N2
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No

Differential Surface Area vs. Pore Width



Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

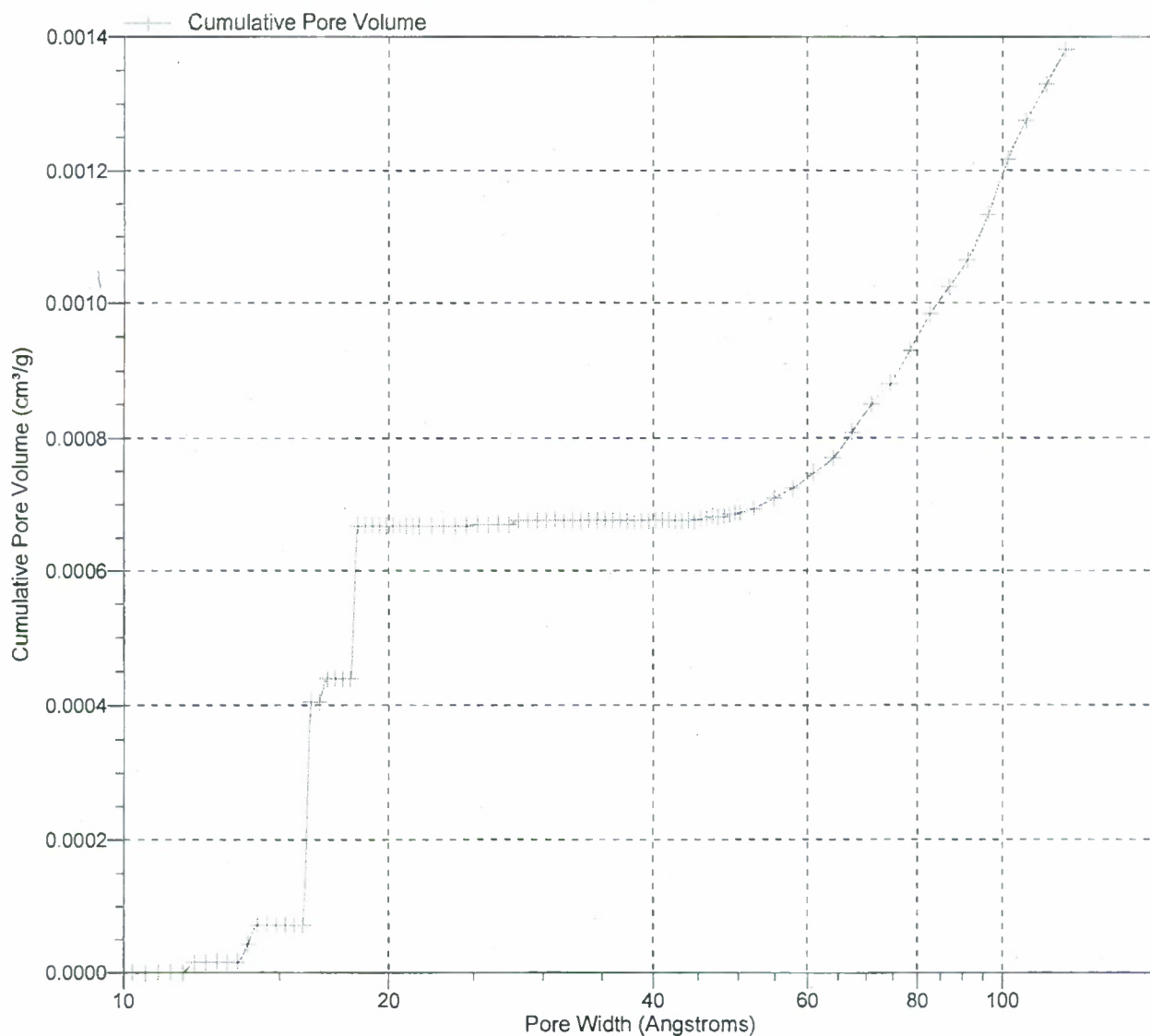
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Sample: CZ2004 Q3
Operator: AT
Submitter: SAIC
File: C:\2420\2007\10OCT\07-4316.SMP

Started: 10/26/2007 3:36:45PM
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Sample Mass: 0.5100 g
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Analysis Adsorptive: N2
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No

Cumulative Pore Volume vs. Pore Width





Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

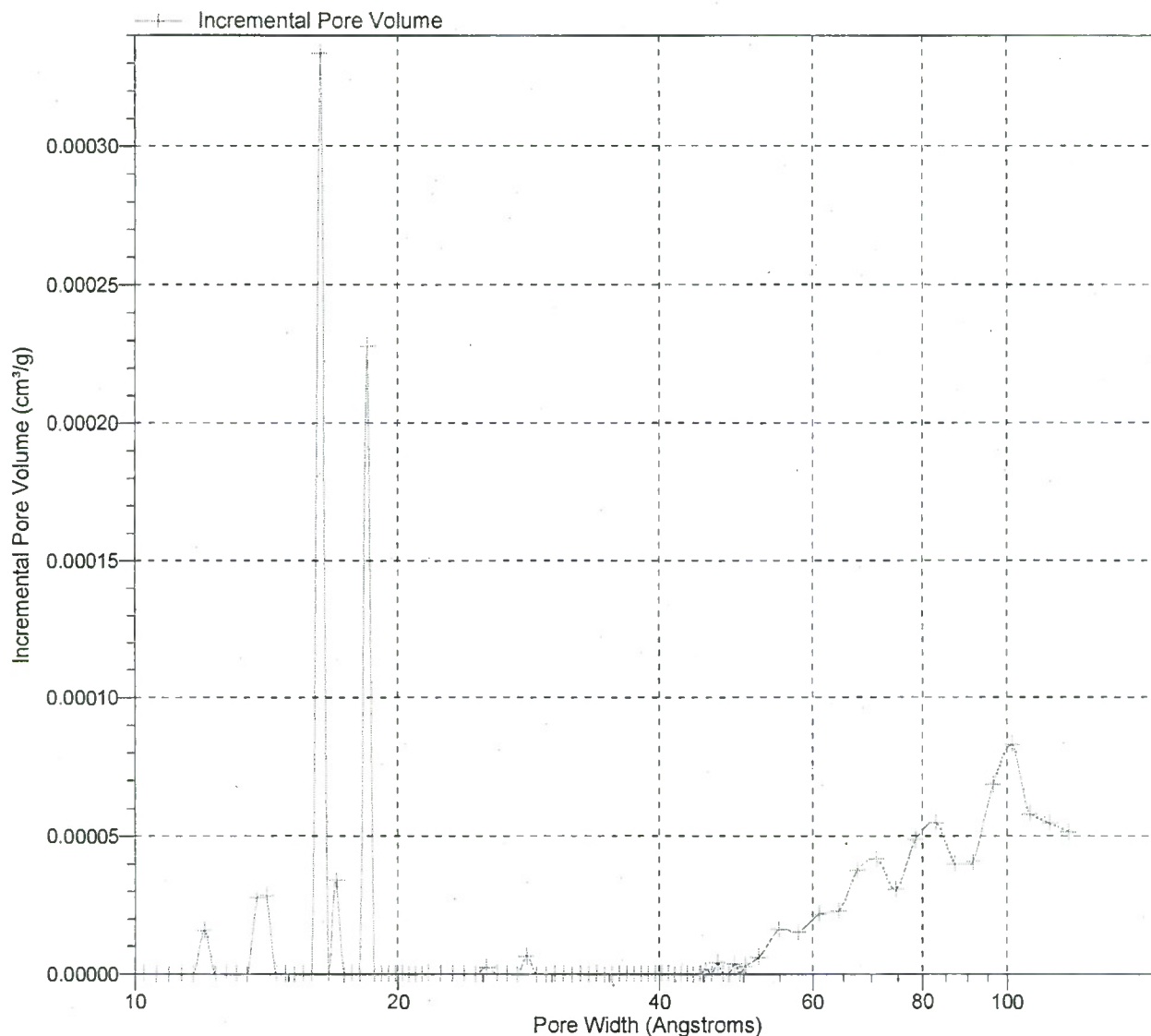
Page 19

Sample: CZ2004 Q3
Operator: AT
Submitter: SAIC
File: C:\2420\2007\10OCT\07-4316.SMP

Started: 10/26/2007 3:36:45PM
Completed: 10/27/2007 2:12:52AM
Report Time: 10/30/2007 9:27:00AM
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Low Pressure Dose: 0.200 cm³/g STP

Analysis Adsorptive: N2
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No

Incremental Pore Volume vs. Pore Width





Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

Serial #: 106

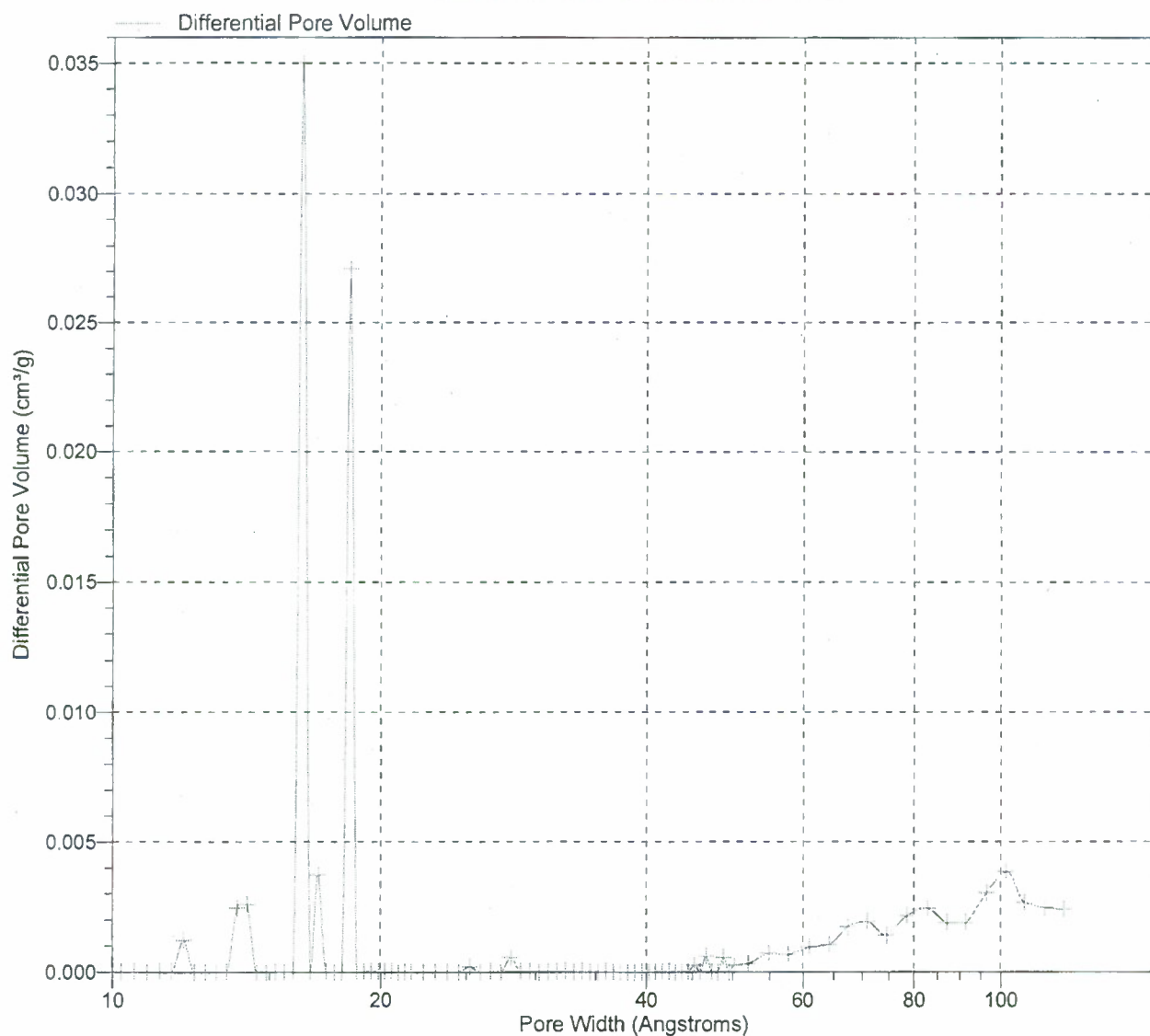
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Sample: CZ2004 Q3
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Analysis Adsorptive: N2
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No

Differential Pore Volume vs. Pore Width





Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

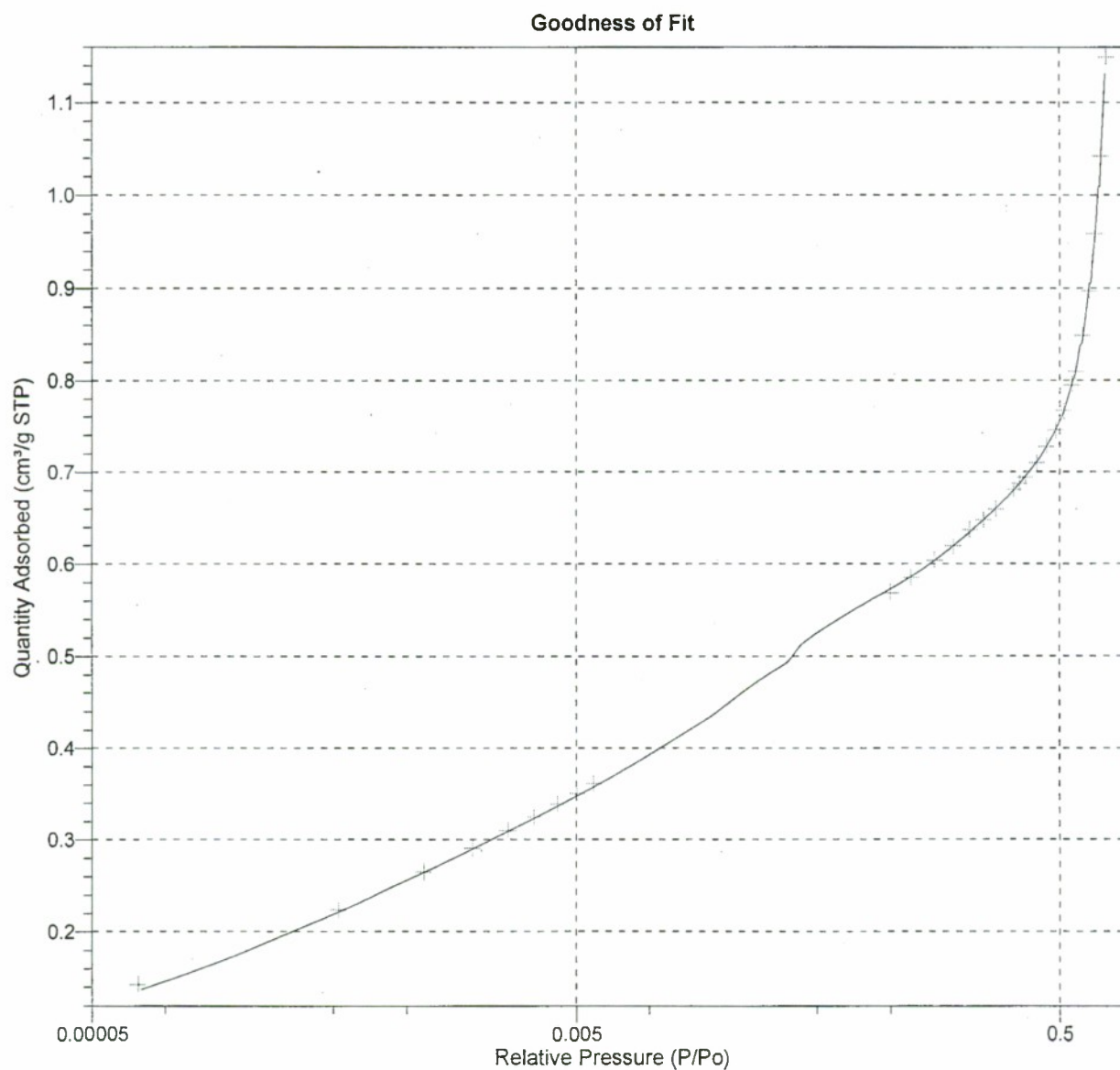
Serial #: 106

Page 21

Sample: CZ2004 Q3
Operator: AT
Submitter: SAIC
File: C:\2420\2007\10OCT\07-4316.SMP

Started: 10/26/2007 3:36:45PM
Completed: 10/27/2007 2:12:52AM
Report Time: 10/30/2007 9:27:00AM
Sample Mass: 0.5100 g
Cold Free Space: 86.7000 cm³
Low Pressure Dose: 0.200 cm³/g STP

Analysis Adsorptive: N2
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No





Surface Area Reports

ASAP 2420 V2.02 J

Unit 2 Port 4

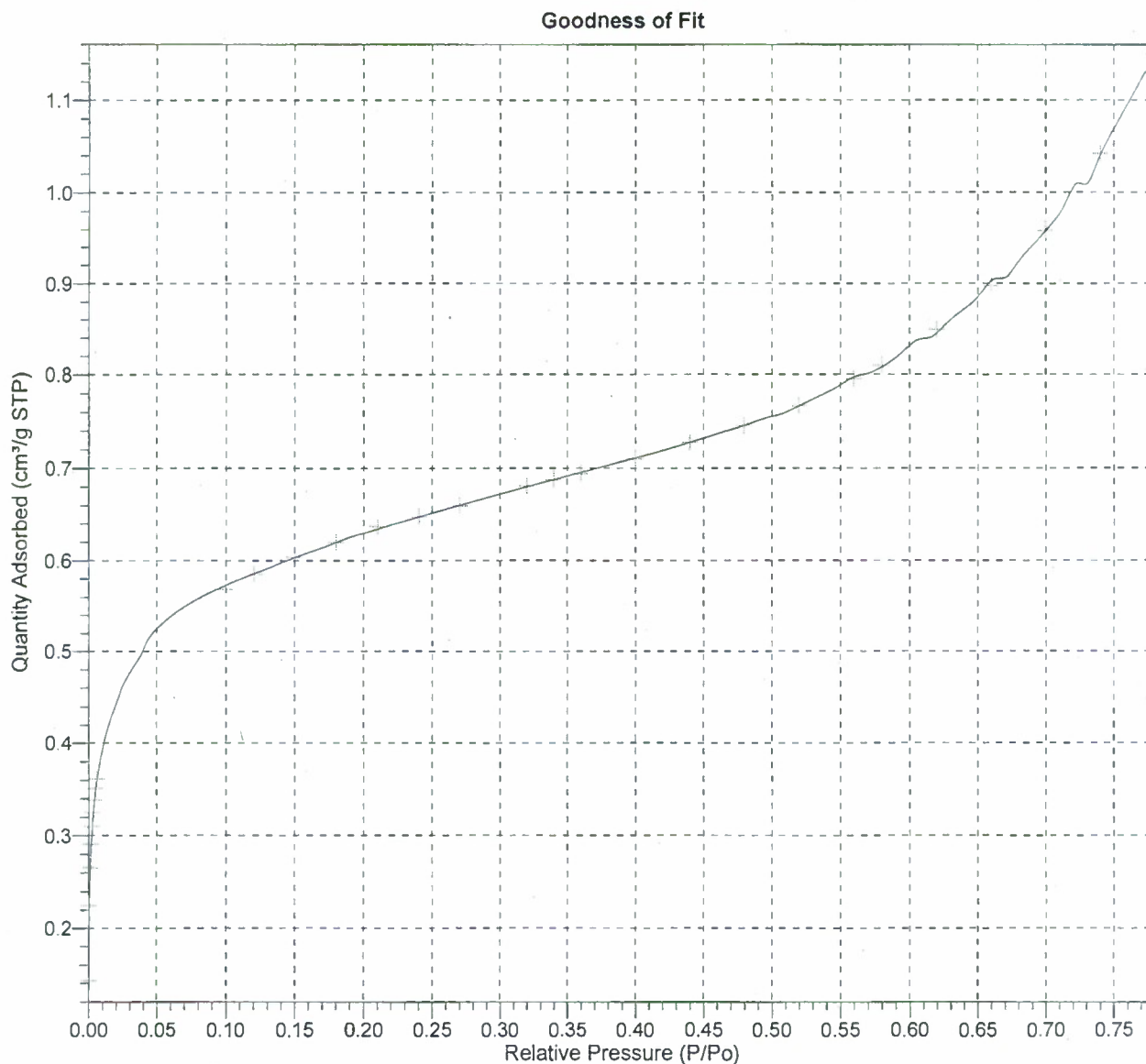
Serial #: 106

Page 22

Sample: CZ2004 Q3
Operator: AT
Submitter: SAIC
File: C:\2420\2007\10OCT\07-4316.SMP

Started: 10/26/2007 3:36:45PM
Completed: 10/27/2007 2:12:52AM
Report Time: 10/30/2007 9:27:00AM
Sample Mass: 0.5100 g
Cold Free Space: 86.7000 cm³
Low Pressure Dose: 0.200 cm³/g STP

Analysis Adsorptive: N₂
Analysis Bath Temp.: 77.300 K
Thermal Correction: No
Warm Free Space: 28.2500 cm³ Entered
Equilibration Interval: 20 s
Automatic Degas: No



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APPENDIX B

MIP DATA FOR CONCRETE C04



Micromeritics Instrument Corporation

AutoPore IV 9500 V1.06

Serial: 454

Port: 1/1

Page 1

Sample: CB6-17 A11P 0345-1-454
 Operator: Chris Brown
 Submitter: Aberdeen Proving Ground
 File: C:\9500\DATA\2005\02\FEB\05-0345.SMP

LP Analysis Time: 2/21/2005 12:18:32PM
 HP Analysis Time: 2/21/2005 2:05:12PM
 Report Time: 2/21/2005 2:05:13PM

Sample Weight: 1.9471 g
 Correction Type: None
 Show Neg. Int: No

Summary Report

Penetrometer parameters

Penetrometer: 200 - (07) 5 Bulb, 0.392 Stem, Solid
 Pen. Constant: 10.790 $\mu\text{L/pF}$ Pen. Weight: 56.5304 g
 Stem Volume: 0.3920 mL Max. Head Pressure: 4.4500 psia
 Pen. Volume: 6.0041 mL Assembly Weight: 127.8532 g

Hg Parameters

Adv. Contact Angle: 130.000 degrees Rec. Contact Angle: 130.000 degrees
 Hg Surface Tension: 485.000 dynes/cm Hg Density: 13.5335 g/mL

Low Pressure:

Evacuation Pressure: 50 μmHg
 Evacuation Time: 5 mins
 Mercury Filling Pressure: 0.51 psia
 Equilibration Time: 10 secs

High Pressure:

Equilibration Time: 10 secs

No Blank Correction

Intrusion Data Summary

Total Intrusion Volume = 0.0574 mL/g
 Total Pore Area = 10.364 m^2/g
 Median Pore Diameter (Volume) = 0.0895 μm
 Median Pore Diameter (Area) = 0.0050 μm
 Average Pore Diameter (4V/A) = 0.0222 μm
 Bulk Density at 0.51 psia = 2.2180 g/mL
 Apparent (skeletal) Density = 2.5417 g/mL
 Porosity = 12.7387 %
 Stem Volume Used = 29 %



Micromeritics Instrument Corporation

AutoPore IV 9500 V1.06

Serial: 454

Port: 1/1

Page 2

Sample: CB6-17 A11P 0345-1-454
 Operator: Chris Brown
 Submitter: Aberdeen Proving Ground
 File: C:\9500\DATA\2005\02FEB\05-0345.SMP

LP Analysis Time: 2/21/2005 12:18:32PM
 HP Analysis Time: 2/21/2005 2:05:12PM
 Report Time: 2/21/2005 2:05:13PM

Sample Weight: 1.9471 g
 Correction Type: None
 Show Neg. Int: No

Tabular Report

Pressure (psia)	Pore Diameter (μ m)	Cumulative Pore Volume (mL/g)	Incremental Pore Volume (mL/g)	Cumulative Pore Area (m ² /g)	Incremental Pore Area (m ² /g)
0.51	352.3728	0.0000	0.0000	0.000	0.000
0.75	240.1598	0.0010	0.0010	0.000	0.000
1.00	180.5694	0.0015	0.0005	0.000	0.000
1.98	91.1617	0.0025	0.0010	0.000	0.000
2.98	60.7556	0.0029	0.0004	0.000	0.000
3.98	45.4396	0.0032	0.0003	0.000	0.000
5.47	33.0521	0.0035	0.0003	0.000	0.000
6.97	25.9409	0.0036	0.0002	0.000	0.000
8.47	21.3432	0.0038	0.0001	0.000	0.000
10.47	17.2822	0.0039	0.0002	0.000	0.000
12.96	13.9595	0.0041	0.0002	0.000	0.000
15.99	11.3114	0.0043	0.0002	0.000	0.000
19.98	9.0534	0.0045	0.0002	0.000	0.000
22.97	7.8739	0.0046	0.0001	0.000	0.000
24.97	7.2438	0.0047	0.0001	0.000	0.000
29.95	6.0386	0.0049	0.0002	0.001	0.000
37.08	4.8773	0.0051	0.0002	0.001	0.000
46.42	3.8963	0.0053	0.0002	0.001	0.000
56.71	3.1895	0.0056	0.0003	0.001	0.000
71.25	2.5385	0.0059	0.0003	0.002	0.000
86.81	2.0835	0.0064	0.0004	0.003	0.001
111.22	1.6262	0.0072	0.0008	0.004	0.002
136.80	1.3221	0.0078	0.0006	0.006	0.002
171.23	1.0563	0.0088	0.0010	0.009	0.003
216.79	0.8343	0.0099	0.0011	0.014	0.005
265.96	0.6800	0.0109	0.0010	0.019	0.005
327.36	0.5525	0.0120	0.0011	0.026	0.007
417.11	0.4336	0.0136	0.0016	0.039	0.013
518.77	0.3486	0.0152	0.0016	0.056	0.017
641.01	0.2822	0.0169	0.0016	0.077	0.021
697.43	0.2593	0.0176	0.0007	0.087	0.011
797.51	0.2268	0.0188	0.0012	0.107	0.020
987.42	0.1832	0.0208	0.0021	0.147	0.040
1196.76	0.1511	0.0229	0.0020	0.195	0.048
1297.44	0.1394	0.0237	0.0008	0.218	0.023
1396.76	0.1295	0.0245	0.0008	0.242	0.024
1496.25	0.1209	0.0252	0.0007	0.265	0.024
1596.92	0.1133	0.0259	0.0007	0.289	0.024
1697.41	0.1066	0.0266	0.0007	0.314	0.025
1895.69	0.0954	0.0279	0.0013	0.366	0.052
2046.85	0.0884	0.0289	0.0010	0.408	0.042



Micromeritics Instrument Corporation

AutoPore IV 9500 V1.06

Serial: 454

Port: 1/1

Page 3

Sample: CB6-17 A11P 0345-1-454
 Operator: Chris Brown
 Submitter: Aberdeen Proving Ground
 File: C:\9500\DATA\2005\02FEB\05-0345.SMP

LP Analysis Time: 2/21/2005 12:18:32PM
 HP Analysis Time: 2/21/2005 2:05:12PM
 Report Time: 2/21/2005 2:05:13PM

Sample Weight: 1.9471 g
 Correction Type: None
 Show Neg. Int: No

Tabular Report

Pressure (psia)	Pore Diameter (μ m)	Cumulative Pore Volume (mL/g)	Incremental Pore Volume (mL/g)	Cumulative Pore Area (m ² /g)	Incremental Pore Area (m ² /g)
2194.94	0.0824	0.0298	0.0009	0.450	0.041
2345.59	0.0771	0.0307	0.0009	0.497	0.047
2497.88	0.0724	0.0316	0.0009	0.545	0.048
2646.44	0.0683	0.0325	0.0009	0.594	0.049
2694.57	0.0671	0.0327	0.0003	0.610	0.016
2844.70	0.0636	0.0335	0.0008	0.658	0.048
2993.38	0.0604	0.0343	0.0008	0.707	0.050
3240.34	0.0558	0.0354	0.0011	0.785	0.077
3489.36	0.0518	0.0365	0.0011	0.864	0.079
3739.19	0.0484	0.0374	0.0009	0.938	0.074
3988.76	0.0453	0.0382	0.0008	1.007	0.070
4237.95	0.0427	0.0389	0.0007	1.071	0.064
4482.72	0.0403	0.0396	0.0007	1.141	0.070
4723.79	0.0383	0.0402	0.0006	1.198	0.057
4983.40	0.0363	0.0408	0.0006	1.258	0.060
5284.25	0.0342	0.0413	0.0006	1.321	0.063
5481.01	0.0330	0.0417	0.0003	1.362	0.041
5729.64	0.0316	0.0421	0.0004	1.410	0.049
5980.00	0.0302	0.0424	0.0004	1.459	0.048
6231.03	0.0290	0.0428	0.0004	1.508	0.050
6480.96	0.0279	0.0431	0.0003	1.550	0.042
6731.71	0.0269	0.0433	0.0002	1.586	0.036
6981.52	0.0259	0.0437	0.0003	1.634	0.048
7484.01	0.0242	0.0442	0.0005	1.714	0.079
7983.19	0.0227	0.0446	0.0004	1.789	0.076
8481.23	0.0213	0.0450	0.0004	1.859	0.069
8984.08	0.0201	0.0453	0.0003	1.925	0.066
9280.94	0.0195	0.0455	0.0002	1.962	0.037
9578.38	0.0189	0.0457	0.0002	2.003	0.040
10029.38	0.0180	0.0460	0.0003	2.059	0.057
10481.21	0.0173	0.0462	0.0002	2.114	0.055
10982.58	0.0165	0.0464	0.0002	2.151	0.037
11480.25	0.0158	0.0466	0.0002	2.210	0.059
11977.56	0.0151	0.0468	0.0002	2.256	0.047
12580.73	0.0144	0.0470	0.0002	2.319	0.062
13078.83	0.0138	0.0472	0.0002	2.365	0.047
13629.91	0.0133	0.0474	0.0002	2.420	0.054
13973.51	0.0129	0.0475	0.0001	2.453	0.033
14318.20	0.0126	0.0476	0.0001	2.489	0.036
14576.37	0.0124	0.0477	0.0001	2.518	0.029
14974.94	0.0121	0.0478	0.0001	2.550	0.033



Micromeritics Instrument Corporation

AutoPore IV 9500 V1.06

Serial: 454

Port: 1/1

Page 4

Sample: CB6-17 A11P 0345-1-454
 Operator: Chris Brown
 Submitter: Aberdeen Proving Ground
 File: C:\9500\DATA\2005\02\FEB\05-0345.SMP

LP Analysis Time: 2/21/2005 12:18:32PM
 HP Analysis Time: 2/21/2005 2:05:12PM
 Report Time: 2/21/2005 2:05:13PM

Sample Weight: 1.9471 g
 Correction Type: None
 Show Neg. Int: No

Tabular Report

Pressure (psia)	Pore Diameter (μ m)	Cumulative Pore Volume (mL/g)	Incremental Pore Volume (mL/g)	Cumulative Pore Area (m ² /g)	Incremental Pore Area (m ² /g)
15426.17	0.0117	0.0479	0.0001	2.596	0.046
15776.51	0.0115	0.0480	0.0001	2.635	0.038
16173.57	0.0112	0.0481	0.0001	2.674	0.040
16628.70	0.0109	0.0482	0.0001	2.714	0.040
16976.75	0.0107	0.0483	0.0001	2.750	0.036
17326.60	0.0104	0.0484	0.0001	2.785	0.035
17674.31	0.0102	0.0485	0.0001	2.821	0.037
18075.03	0.0100	0.0486	0.0001	2.864	0.043
18417.93	0.0098	0.0487	0.0001	2.894	0.030
18770.23	0.0096	0.0488	0.0001	2.935	0.041
19173.21	0.0094	0.0489	0.0001	2.972	0.037
19773.34	0.0091	0.0490	0.0001	3.028	0.055
20278.05	0.0089	0.0491	0.0001	3.079	0.051
20781.08	0.0087	0.0493	0.0002	3.150	0.071
21182.32	0.0085	0.0494	0.0001	3.196	0.046
21634.08	0.0084	0.0495	0.0001	3.242	0.046
22035.52	0.0082	0.0496	0.0001	3.291	0.048
22639.52	0.0080	0.0497	0.0001	3.338	0.047
23188.75	0.0078	0.0498	0.0001	3.395	0.058
23739.75	0.0076	0.0499	0.0001	3.464	0.069
24089.06	0.0075	0.0500	0.0001	3.515	0.051
24641.38	0.0073	0.0501	0.0001	3.548	0.033
25040.78	0.0072	0.0502	0.0001	3.583	0.035
25441.57	0.0071	0.0503	0.0001	3.659	0.076
25893.05	0.0070	0.0504	0.0001	3.708	0.049
26442.17	0.0068	0.0505	0.0001	3.770	0.062
26942.93	0.0067	0.0506	0.0001	3.811	0.041
27394.00	0.0066	0.0506	0.0001	3.868	0.057
27793.68	0.0065	0.0507	0.0001	3.927	0.059
28243.61	0.0064	0.0508	0.0001	3.992	0.066
28994.39	0.0062	0.0510	0.0001	4.076	0.084
29495.29	0.0061	0.0511	0.0001	4.168	0.092
29994.15	0.0060	0.0512	0.0001	4.223	0.056
30443.35	0.0059	0.0513	0.0001	4.311	0.087
30894.49	0.0059	0.0514	0.0001	4.358	0.047
31295.21	0.0058	0.0515	0.0001	4.444	0.087
31793.86	0.0057	0.0516	0.0001	4.498	0.054
32345.40	0.0056	0.0518	0.0002	4.618	0.120
32893.66	0.0055	0.0519	0.0001	4.700	0.082
33493.97	0.0054	0.0521	0.0002	4.820	0.120
33993.70	0.0053	0.0522	0.0001	4.917	0.097



Micromeritics Instrument Corporation

AutoPore IV 9500 V1.06

Serial: 454

Port: 1/1

Page 5

Sample: CB6-17 A11P 0345-1-454
 Operator: Chris Brown
 Submitter: Aberdeen Proving Ground
 File: C:\9500\DATA\2005\02FEB\05-0345.SMP

LP Analysis Time: 2/21/2005 12:18:32PM
 HP Analysis Time: 2/21/2005 2:05:12PM
 Report Time: 2/21/2005 2:05:13PM

Sample Weight: 1.9471 g
 Correction Type: None
 Show Neg. Int: No

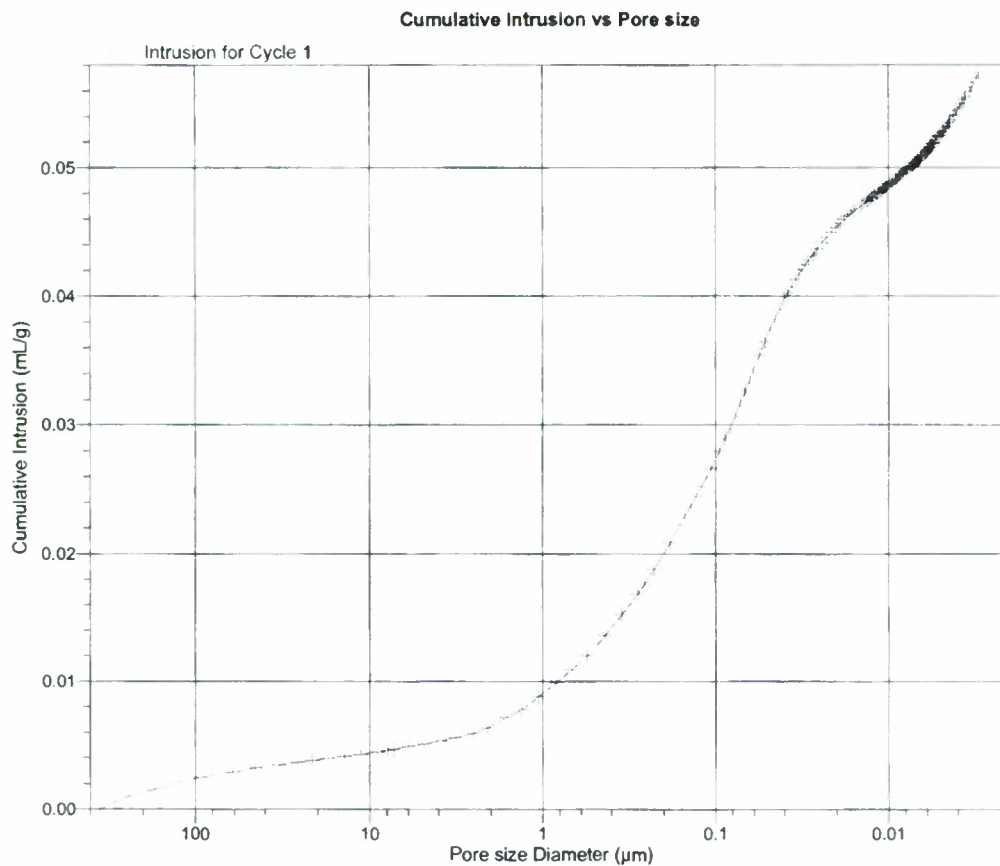
Tabular Report

Pressure (psia)	Pore Diameter (μ m)	Cumulative Pore Volume (mL/g)	Incremental Pore Volume (mL/g)	Cumulative Pore Area (m ² /g)	Incremental Pore Area (m ² /g)
34645.71	0.0052	0.0524	0.0002	5.068	0.151
35495.03	0.0051	0.0525	0.0001	5.144	0.076
36192.21	0.0050	0.0525	0.0000	5.152	0.009
36996.43	0.0049	0.0527	0.0002	5.312	0.159
37646.09	0.0048	0.0529	0.0002	5.451	0.139
38446.43	0.0047	0.0530	0.0002	5.596	0.146
39196.05	0.0046	0.0532	0.0002	5.745	0.149
39994.14	0.0045	0.0534	0.0002	5.910	0.164
40492.23	0.0045	0.0536	0.0002	6.050	0.140
40989.45	0.0044	0.0537	0.0002	6.191	0.141
42486.07	0.0043	0.0540	0.0003	6.496	0.305
43339.62	0.0042	0.0541	0.0001	6.597	0.101
43991.91	0.0041	0.0542	0.0000	6.604	0.008
44987.89	0.0040	0.0545	0.0003	6.934	0.330
46487.99	0.0039	0.0548	0.0003	7.227	0.293
47981.89	0.0038	0.0550	0.0002	7.476	0.250
49484.12	0.0037	0.0553	0.0003	7.832	0.355
50174.77	0.0036	0.0556	0.0002	8.085	0.253
52975.64	0.0034	0.0560	0.0004	8.534	0.448
54472.92	0.0033	0.0563	0.0003	8.916	0.383
55971.32	0.0032	0.0567	0.0004	9.373	0.456
57972.15	0.0031	0.0570	0.0003	9.762	0.389
59973.13	0.0030	0.0574	0.0005	10.364	0.602

Sample: CB6-17 A11P 0345-1-454
 Operator: Chris Brown
 Submitter: Aberdeen Proving Ground
 File: C:\9500\DATA\2005\02FEB\05-0345.SMP

LP Analysis Time: 2/21/2005 12:18:32PM
 HP Analysis Time: 2/21/2005 2:05:12PM
 Report Time: 2/21/2005 2:05:13PM

Sample Weight: 1.9471 g
 Correction Type: None
 Show Neg. Int: No





Micromeritics Instrument Corporation

AutoPore IV 9500 V1.06

Serial: 454

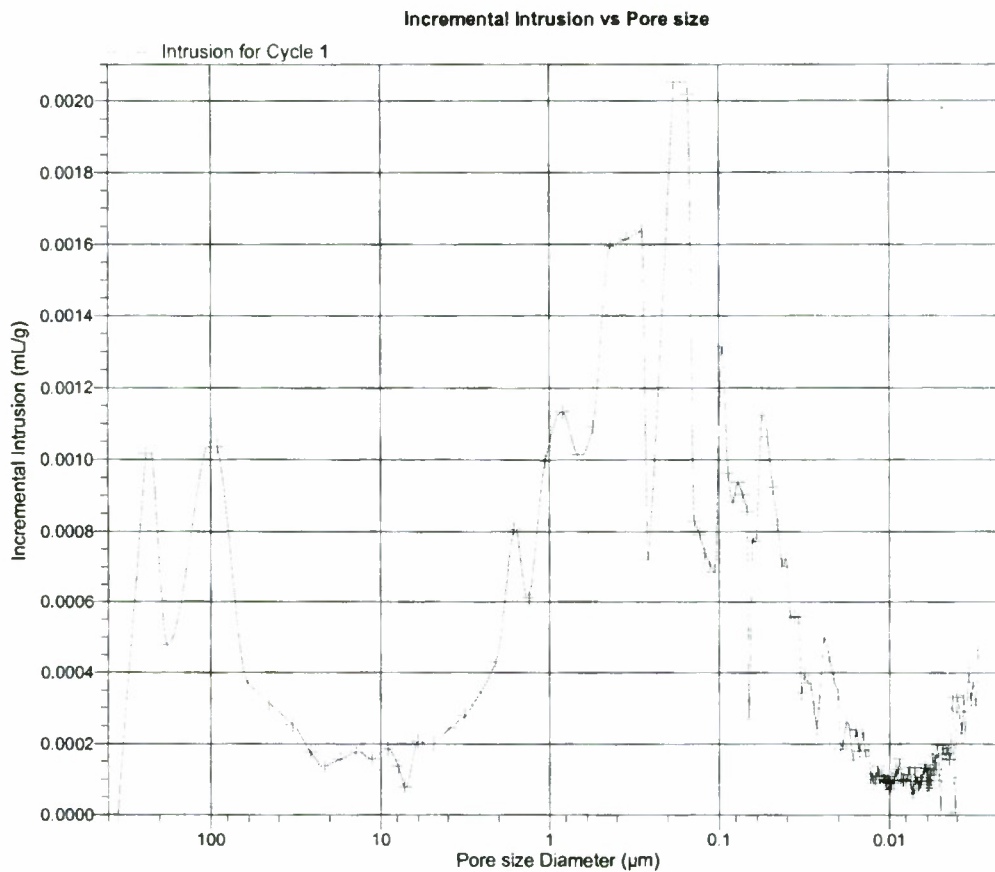
Port: 1/1

Page 7

Sample: CB6-17 A11P 0345-1-454
Operator: Chris Brown
Submitter: Aberdeen Proving Ground
File: C:\9500\DATA\2005\02\FEB\05-0345.SMP

LP Analysis Time: 2/21/2005 12:18:32PM
HP Analysis Time: 2/21/2005 2:05:12PM
Report Time: 2/21/2005 2:05:13PM

Sample Weight: 1.9471 g
Correction Type: None
Show Neg. Int: No





Micromeritics Instrument Corporation

AutoPore IV 9500 V1.06

Serial: 454

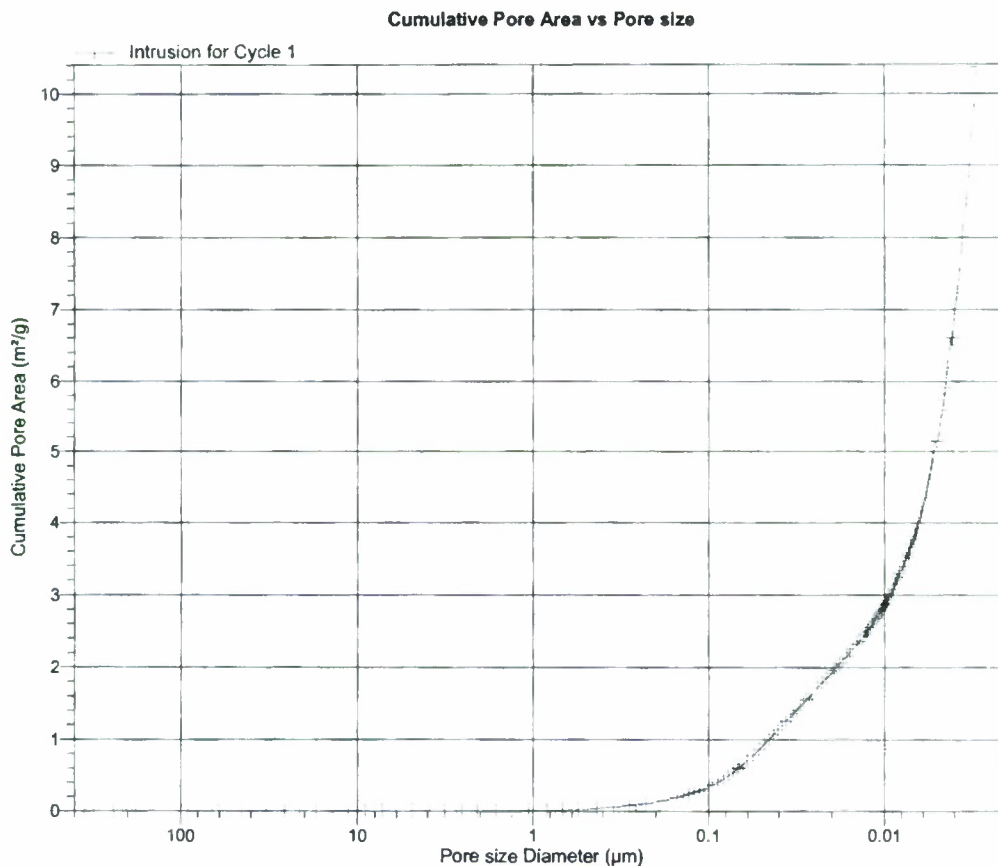
Port: 1/1

Page 8

Sample: CB6-17 A11P 0345-1-454
Operator: Chris Brown
Submitter: Aberdeen Proving Ground
File: C:\9500\DATA\2005\02FEB\05-0345.SMP

LP Analysis Time: 2/21/2005 12:18:32PM
HP Analysis Time: 2/21/2005 2:05:12PM
Report Time: 2/21/2005 2:05:13PM

Sample Weight: 1.9471 g
Correction Type: None
Show Neg. Int: No





Micromeritics Instrument Corporation

AutoPore IV 9500 V1.06

Serial: 454

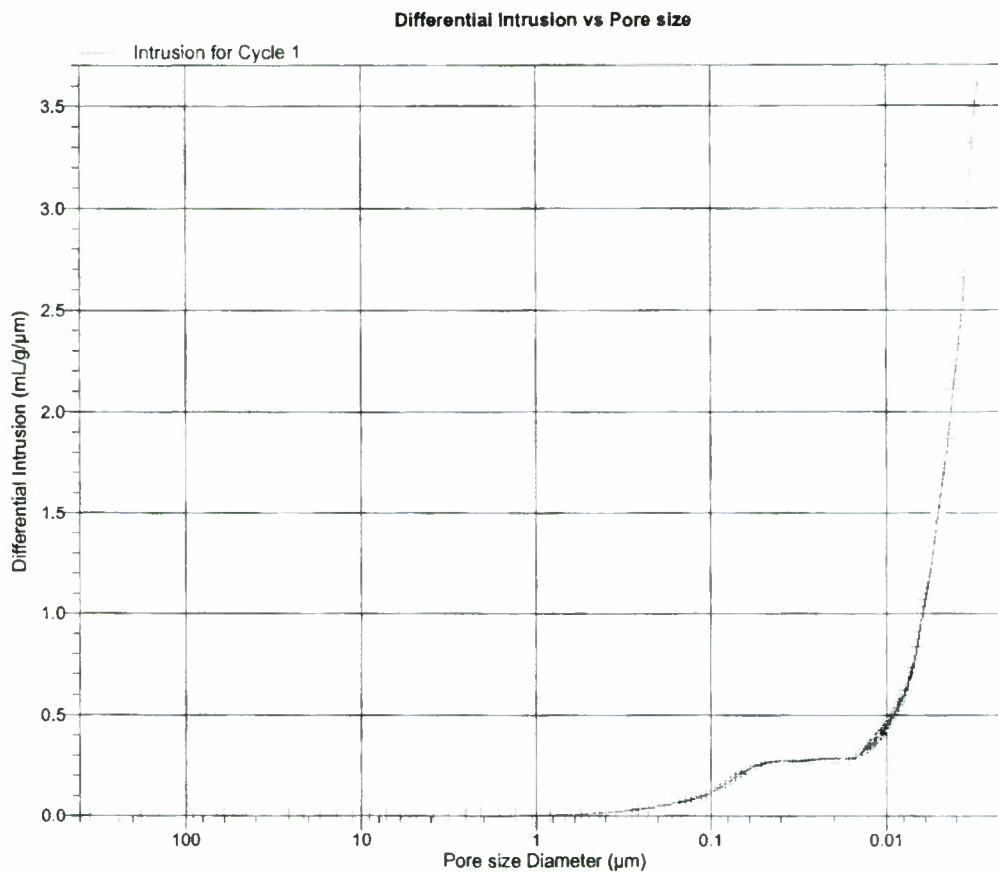
Port: 1/1

Page 9

Sample: CB6-17 A11P 0345-1-454
Operator: Chris Brown
Submitter: Aberdeen Proving Ground
File: C:\9500\DATA\2005\02FEB\05-0345.SMP

LP Analysis Time: 2/21/2005 12:18:32PM
HP Analysis Time: 2/21/2005 2:05:12PM
Report Time: 2/21/2005 2:05:13PM

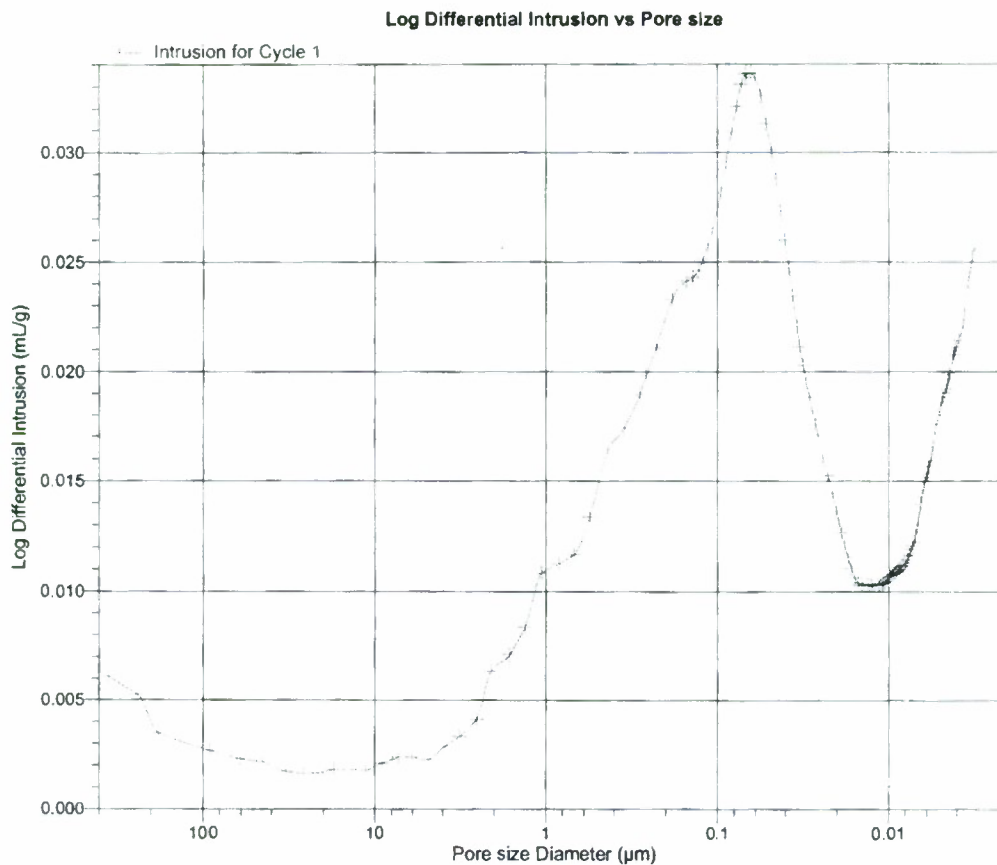
Sample Weight: 1.9471 g
Correction Type: None
Show Neg. Int: No



Sample: CB6-17 A11P 0345-1-454
Operator: Chris Brown
Submitter: Aberdeen Proving Ground
File: C:\9500\DATA\2005\02FEB\05-0345.SMP

LP Analysis Time: 2/21/2005 12:18:32PM
HP Analysis Time: 2/21/2005 2:05:12PM
Report Time: 2/21/2005 2:05:13PM

Sample Weight: 1.9471 g
Correction Type: None
Show Neg. Int: No



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APPENDIX C

MICROPORE DATA FOR A MINISLAB OF C04

TriStar 3000 V6.05 A

Unit 1 Port 1

Serial #: 1098

Page 1

Sample: CB6-17 minislabs 05-0860 K4/K4
 Operator: MJP
 Submitter: Aberdeen Proving Ground
 File: C:\...04APRIL05-0860.SMP

Started: 4/20/2005 4:08:31PM	Analysis Adsorptive: N2
Completed: 4/21/2005 4:54:10AM	Analysis Bath Temp.: 77.300 K
Report Time: 4/21/2005 7:33:54AM	Sample Mass: 3.9107 g
Warm Free Space: 7.6235 cm ³ Measured	Cold Free Space: 21.4787 cm ³ Measured
Equilibration Interval: 15 s	Low Pressure Dose: None
Sample Density: 1.000 g/cm ³	Automatic Degas: Yes

Sample Prep: Stage	Soak Temperature (°C)	Ramp Rate (°C/min)	Soak Time (min)
1	110	10	960

Isotherm Tabular Report

Relative Pressure (P/Po)	Absolute Pressure (mmHg)	Quantity Adsorbed (cm ³ /g STP)	Elapsed Time (h:min)	Saturation Pressure (mmHg)
			01:19	736.47363
0.029856837	21.98620	0.5910	01:42	
0.052483613	38.64709	0.6505	01:48	
0.084510669	62.22880	0.7081	01:54	
0.109623341	80.71909	0.7447	01:57	
0.139632780	102.81389	0.7838	02:01	
0.169717184	124.96298	0.8204	02:05	
0.199836843	147.13713	0.8557	02:09	
0.230047330	169.37811	0.8908	02:12	
0.260343834	191.68175	0.9259	02:15	
0.290614370	213.96449	0.9613	02:19	
0.320986619	236.32242	0.9975	02:22	
0.351265146	258.60934	1.0344	02:26	
0.379534606	279.41769	1.0697	02:29	
0.409444554	301.43314	1.1081	02:32	
0.439363330	323.45276	1.1478	02:36	
0.469354684	345.52667	1.1891	02:39	
0.499304101	367.56717	1.2323	02:43	
0.529257723	389.61185	1.2777	02:46	
0.559129996	411.59387	1.3260	02:50	
0.589168029	433.69702	1.3777	02:54	
0.618946265	455.60803	1.4338	02:58	
0.648887928	477.63602	1.4960	03:03	
0.678672198	499.54703	1.5664	03:08	
0.708486385	521.47894	1.6476	03:13	
			03:19	736.02405
0.738192281	543.32727	1.7432	03:19	
0.767792361	565.11719	1.8593	03:26	
0.801061396	589.60944	2.0318	03:36	
0.819033400	602.84125	2.1492	03:43	
0.837288108	616.28186	2.2989	03:51	
0.860809641	633.60272	2.5541	04:05	
0.876696657	645.30164	2.7891	04:14	
0.888088648	653.69269	3.0043	04:24	

TriStar 3000 V6.05 A

Unit 1 Port 1

Serial #: 1098

Page 2

Sample: CB6-17 minislabs 05-0860 K4/K4
 Operator: MJP
 Submitter: Aberdeen Proving Ground
 File: C:\...04APRIL\05-0860.SMP

Started: 4/20/2005 4:08:31PM	Analysis Adsorptive: N2
Completed: 4/21/2005 4:54:10AM	Analysis Bath Temp: 77.300 K
Report Time: 4/21/2005 7:33:54AM	Sample Mass: 3.9107 g
Warm Free Space: 7.6235 cm ³ Measured	Cold Free Space: 21.4787 cm ³ Measured
Equilibration Interval: 15 s	Low Pressure Dose: None
Sample Density: 1.000 g/cm ³	Automatic Degas: Yes

Sample Prep: Stage	Soak Temperature (°C)	Ramp Rate (°C/min)	Soak Time (min)
1	110	10	960

Isotherm Tabular Report

Relative Pressure (P/Po)	Absolute Pressure (mmHg)	Quantity Adsorbed (cm ³ /g STP)	Elapsed Time (h:min)	Saturation Pressure (mmHg)
0.897932047	660.94342	3.2312	04:33	
0.907342480	667.87677	3.5034	04:44	
0.916854883	674.88531	3.8426	04:55	
0.929956140	684.54187	4.4324	05:16	
			05:20	736.10388
0.937449055	690.09271	4.8908	05:28	
0.949103722	698.75940	5.7528	05:49	
0.953744332	702.23022	6.1737	06:02	
0.957646895	705.15393	6.5829	06:14	
0.963726341	709.72327	7.2714	06:36	
0.966481767	711.80322	7.6394	06:48	
			07:20	736.62909
0.977150154	719.78491	9.3794	07:35	
0.981810552	723.18896	10.4398	08:10	
0.986717268	726.76422	11.8450	08:57	
			09:20	736.52826
0.988971094	728.30542	12.8066	09:40	
0.991233063	729.69629	13.9935	10:35	
0.992391303	730.39380	14.5663	11:06	
			11:20	735.92316
0.997804412	734.30737	17.4953	12:14	
0.995029096	732.26495	17.4044	12:25	
0.992713499	730.56085	17.3308	12:30	
0.992929135	730.71954	17.3237	12:33	
0.991873515	729.94269	17.2462	12:39	
0.990920073	729.24103	17.1673	12:44	

TriStar 3000 V6.05 A

Unit 1 Port 1

Serial #: 1098

Page 3

Sample: CB6-17 minislab 05-0860 K4/K4
 Operator: MJP
 Submitter: Aberdeen Proving Ground
 File: C:\...\04APRIL05-0860.SMP

Started: 4/20/2005 4:08:31PM
 Completed: 4/21/2005 4:54:10AM
 Report Time: 4/21/2005 7:33:54AM
 Warm Free Space: 7.6235 cm³ Measured
 Equilibration Interval: 15 s
 Sample Density: 1.000 g/cm³

Analysis Adsorptive: N2
 Analysis Bath Temp.: 77.300 K
 Sample Mass: 3.9107 g
 Cold Free Space: 21.4787 cm³ Measured
 Low Pressure Dose: None
 Automatic Degas: Yes

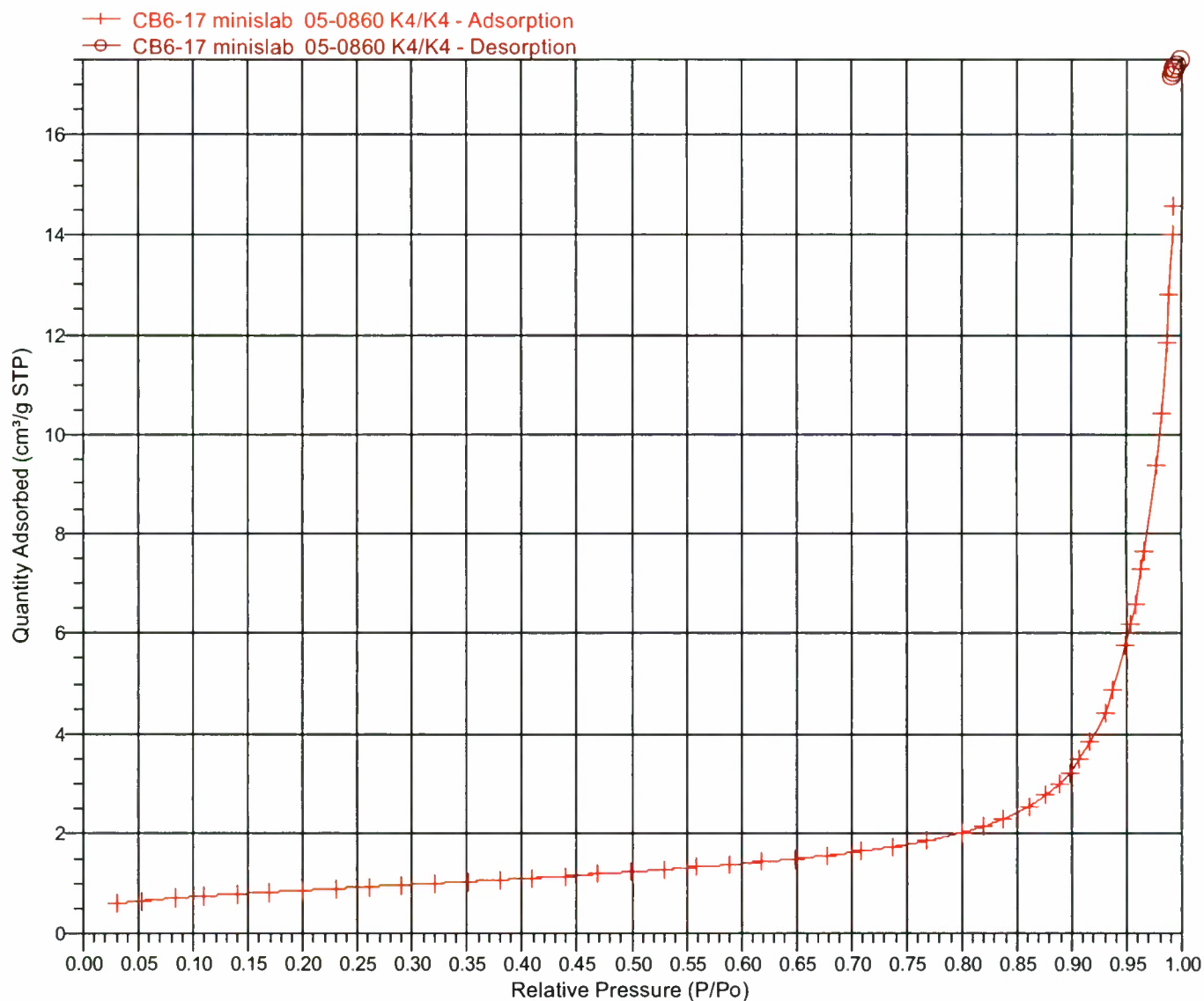
Sample Prep: Stage
 1

Soak Temperature (°C)
 110

Ramp Rate (°C/min)
 10

Soak Time (min)
 960

Isotherm Linear Plot



TriStar 3000 V6.05 A

Unit 1 Port 1

Serial #: 1098

Page 4

Sample: CB6-17 minislabs 05-0860 K4/K4
 Operator: MJP
 Submitter: Aberdeen Proving Ground
 File: C:\...04APRIL\05-0860.SMP

Started: 4/20/2005 4:08:31PM	Analysis Adsorptive: N2
Completed: 4/21/2005 4:54:10AM	Analysis Bath Temp.: 77.300 K
Report Time: 4/21/2005 7:33:54AM	Sample Mass: 3.9107 g
Warm Free Space: 7.6235 cm ³ Measured	Cold Free Space: 21.4787 cm ³ Measured
Equilibration Interval: 15 s	Low Pressure Dose: None
Sample Density: 1.000 g/cm ³	Automatic Degas: Yes

Sample Prep: Stage	Soak Temperature (°C)	Ramp Rate (°C/min)	Soak Time (min)
1	110	10	960

BET Surface Area Report

BET Surface Area: 3.0351 ± 0.0163 m²/g
 Slope: 1.425368 ± 0.007564 g/cm³ STP
 Y-Intercept: 0.008899 ± 0.001416 g/cm³ STP
 C: 161.179930
 Qm: 0.6972 cm³/g STP
 Correlation Coefficient: 0.9999014
 Molecular Cross-Sectional Area: 0.1620 nm²

Relative Pressure (P/Po)	Quantity Adsorbed (cm ³ /g STP)	1/[Q(Po/P - 1)]
0.052483613	0.6505	0.085156
0.084510669	0.7081	0.130359
0.109623341	0.7447	0.165319
0.139632780	0.7838	0.207050
0.169717184	0.8204	0.249159
0.199836843	0.8557	0.291854
0.230047330	0.8908	0.335417
0.260343834	0.9259	0.380149
0.290614370	0.9613	0.426143

TriStar 3000 V6.05 A

Unit 1 Port 1

Serial #: 1098

Page 5

Sample: CB6-17 minislabs 05-0860 K4/K4
 Operator: MJP
 Submitter: Aberdeen Proving Ground
 File: C:\...04APRIL05-0860.SMP

Started: 4/20/2005 4:08:31PM
 Completed: 4/21/2005 4:54:10AM
 Report Time: 4/21/2005 7:33:54AM
 Warm Free Space: 7.6235 cm³ Measured
 Equilibration Interval: 15 s
 Sample Density: 1.000 g/cm³

Analysis Adsorptive: N₂
 Analysis Bath Temp.: 77.300 K
 Sample Mass: 3.9107 g
 Cold Free Space: 21.4787 cm³ Measured
 Low Pressure Dose: None
 Automatic Degas: Yes

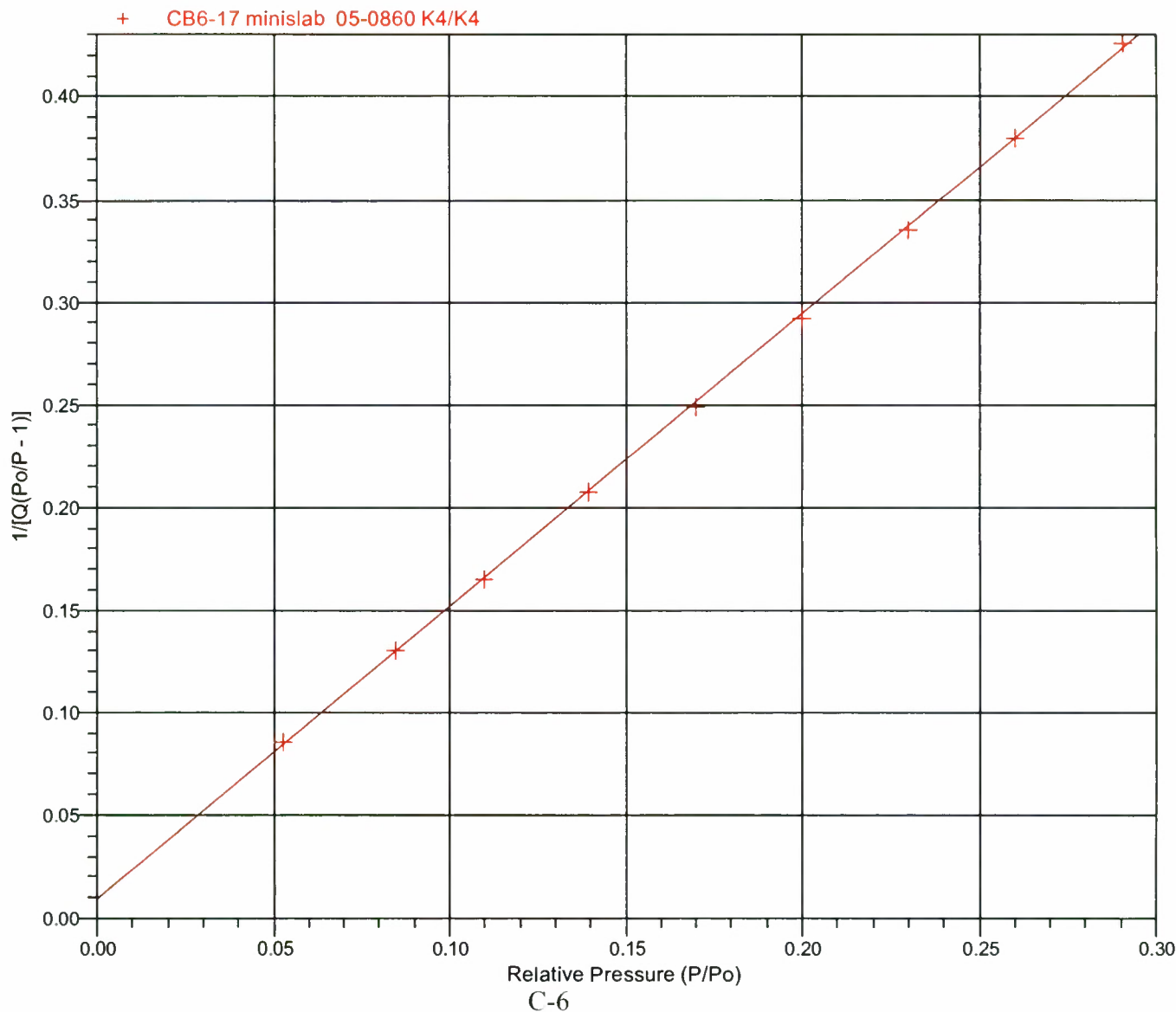
Sample Prep: Stage
 1

Soak Temperature (°C)
 110

Ramp Rate (°C/min)
 10

Soak Time (min)
 960

BET Surface Area Plot



TriStar 3000 V6.05 A

Unit 1 Port 1

Serial #: 1098

Page 6

Sample: CB6-17 minislabs 05-0860 K4/K4
 Operator: MJP
 Submitter: Aberdeen Proving Ground
 File: C:\...04APRIL05-0860.SMP

Started: 4/20/2005 4:08:31PM	Analysis Adsorptive: N2
Completed: 4/21/2005 4:54:10AM	Analysis Bath Temp.: 77.300 K
Report Time: 4/21/2005 7:33:54AM	Sample Mass: 3.9107 g
Warm Free Space: 7.6235 cm ³ Measured	Cold Free Space: 21.4787 cm ³ Measured
Equilibration Interval: 15 s	Low Pressure Dose: None
Sample Density: 1.000 g/cm ³	Automatic Degas: Yes

Sample Prep: Stage	Soak Temperature (°C)	Ramp Rate (°C/min)	Soak Time (min)
1	110	10	960

t-Plot Report

Micropore Volume: 0.000137 cm³/g STP
 Micropore Area: 0.2953 m²/g
 External Surface Area: 2.7399 m²/g
 Slope: 0.177130 ± 0.000414 cm³/g·Å STP
 Y-Intercept: 0.088426 ± 0.002916 cm³/g STP
 Correlation Coefficient: 0.999986
 Surface Area Correction Factor: 1.000
 Density Conversion Factor: 0.0015468
 Total Surface Area (BET): 3.0351 m²/g
 Thickness Range: 6.0000 Å to 8.0000 Å
 Thickness Equation: Harkins and Jura

$$t = [13.99 / (0.034 - \log(P/P_o))]^{0.5}$$

Relative Pressure (P/P _o)	Statistical Thickness (Å)	Quantity Adsorbed (cm ³ /g STP)
0.052483613	3.2630	0.6505
0.084510669	3.5548	0.7081
0.109623341	3.7514	0.7447
0.139632780	3.9669	0.7838
0.169717184	4.1707	0.8204
0.199836843	4.3678	0.8557
0.230047330	4.5621	0.8908
0.260343834	4.7562	0.9259
0.290614370	4.9512	0.9613
0.320986619	5.1498	0.9975
0.351265146	5.3523	1.0344
0.379534606	5.5466	1.0697
0.409444554	5.7591	1.1081
0.439363330	5.9803	1.1478
0.469354684	6.2123	1.1891
0.499304101	6.4562	1.2323
0.529257723	6.7142	1.2777
0.559129996	6.9881	1.3260
0.589168029	7.2829	1.3777
0.618946265	7.5978	1.4338
0.648887928	7.9414	1.4960

TriStar 3000 V6.05 A

Unit 1 Port 1

Serial #: 1098

Page 7

Sample: CB6-17 minislabs 05-0860 K4/K4
 Operator: MJP
 Submitter: Aberdeen Proving Ground
 File: C:\...04APRIL05-0860.SMP

Started: 4/20/2005 4:08:31PM	Analysis Adsorptive: N2
Completed: 4/21/2005 4:54:10AM	Analysis Bath Temp.: 77.300 K
Report Time: 4/21/2005 7:33:54AM	Sample Mass: 3.9107 g
Warm Free Space: 7.6235 cm ³ Measured	Cold Free Space: 21.4787 cm ³ Measured
Equilibration Interval: 15 s	Low Pressure Dose: None
Sample Density: 1.000 g/cm ³	Automatic Degas: Yes

Sample Prep: Stage	Soak Temperature (°C)	Ramp Rate (°C/min)	Soak Time (min)
1	110	10	960

Relative Pressure (P/Po)	Statistical Thickness (Å)	Quantity Adsorbed (cm ³ /g STP)
0.678672198	8.3151	1.5664
0.708486385	8.7275	1.6476
0.738192281	9.1849	1.7432
0.767792361	9.6978	1.8593
0.801061396	10.3605	2.0318

TriStar 3000 V6.05 A

Unit 1 Port 1

Serial #: 1098

Page 8

Sample: CB6-17 minislab 05-0860 K4/K4
 Operator: MJP
 Submitter: Aberdeen Proving Ground
 File: C:\...\04APRIL\05-0860.SMP

Started: 4/20/2005 4:08:31PM
 Completed: 4/21/2005 4:54:10AM
 Report Time: 4/21/2005 7:33:54AM
 Warm Free Space: 7.6235 cm³ Measured
 Equilibration Interval: 15 s
 Sample Density: 1.000 g/cm³

Analysis Adsorptive: N₂
 Analysis Bath Temp.: 77.300 K
 Sample Mass: 3.9107 g
 Cold Free Space: 21.4787 cm³ Measured
 Low Pressure Dose: None
 Automatic Degas: Yes

Sample Prep: Stage
 1

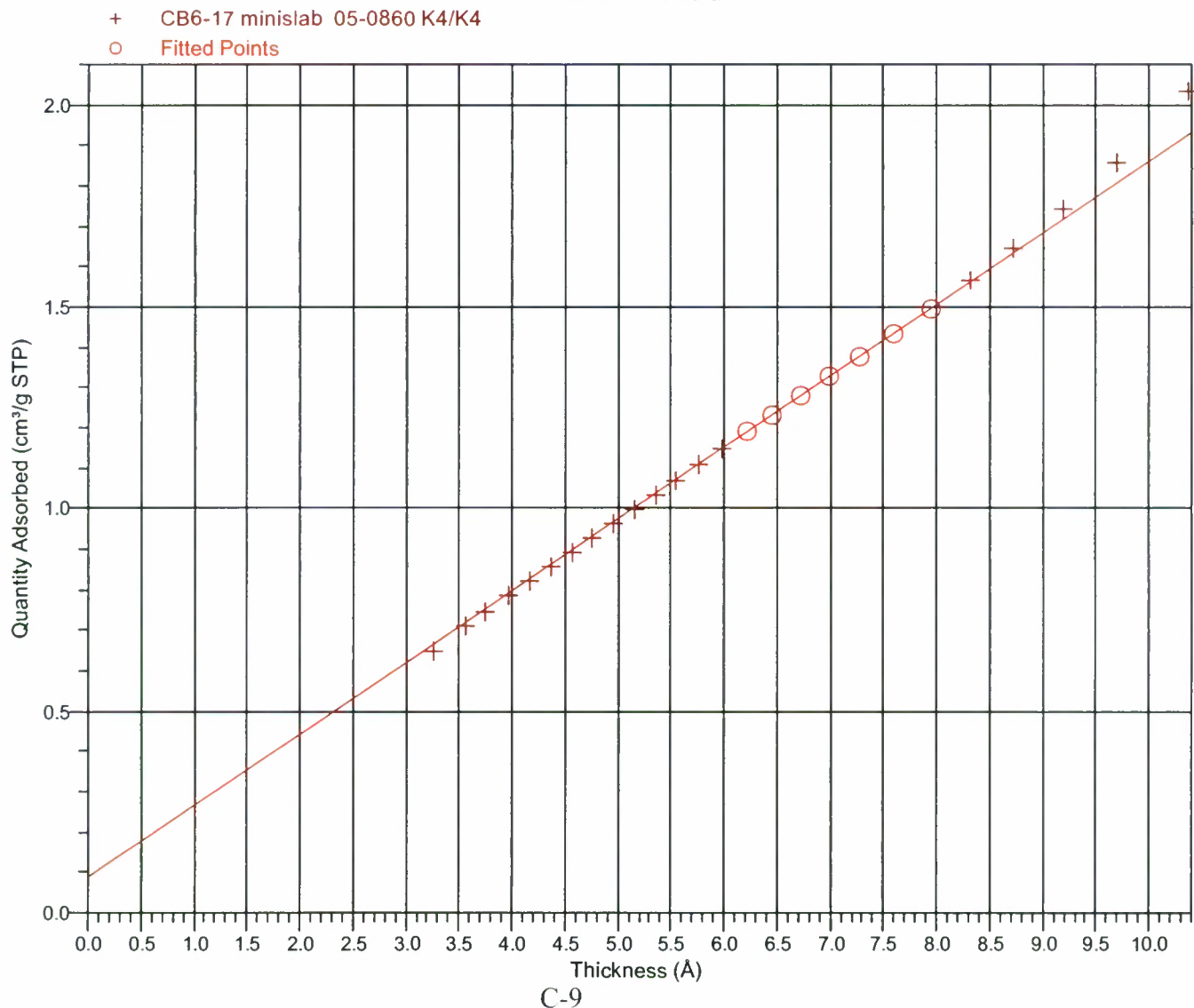
Soak Temperature (°C)
 110

Ramp Rate (°C/min)
 10

Soak Time (min)
 960

t-Plot

Harkins and Jura



TriStar 3000 V6.05 A

Unit 1 Port 1

Serial #: 1098

Page 9

Sample: CB6-17 minislabs 05-0860 K4/K4

Operator: MJP

Submitter: Aberdeen Proving Ground

File: C:\...104APRIL05-0860.SMP

Started: 4/20/2005 4:08:31PM	Analysis Adsorptive: N2
Completed: 4/21/2005 4:54:10AM	Analysis Bath Temp.: 77.300 K
Report Time: 4/21/2005 7:33:54AM	Sample Mass: 3.9107 g
Warm Free Space: 7.6235 cm ³ Measured	Cold Free Space: 21.4787 cm ³ Measured
Equilibration Interval: 15 s	Low Pressure Dose: None
Sample Density: 1.000 g/cm ³	Automatic Degas: Yes

Sample Prep: Stage	Soak Temperature (°C)	Ramp Rate (°C/min)	Soak Time (min)
1	110	10	960

BJH Adsorption Pore Distribution Report

$$t = 3.54 \left[-5 / \ln(P/P_0) \right]^{0.333}$$

Diameter Range: 17.000 Å to 3000.000 Å

Adsorbate Property Factor: 9.53000 Å

Density Conversion Factor: 0.0015468

Fraction of Pores Open at Both Ends: 0.00

Pore Diameter Range (Å)	Average Diameter (Å)	Incremental Pore Volume (cm ³ /g)	Cumulative Pore Volume (cm ³ /g)	Incremental Pore Area (m ² /g)	Cumulative Pore Area (m ² /g)
1474.9 - 1082.7	1218.8	0.002341	0.002341	0.077	0.077
1082.7 - 865.6	949.7	0.001778	0.004119	0.075	0.152
865.6 - 595.0	680.3	0.002958	0.007077	0.174	0.326
595.0 - 550.8	571.1	0.000628	0.007705	0.044	0.370
550.8 - 473.5	506.1	0.001181	0.008886	0.093	0.463
473.5 - 434.5	452.2	0.000707	0.009594	0.063	0.526
434.5 - 395.8	413.3	0.000729	0.010323	0.071	0.596
395.8 - 323.8	352.3	0.001507	0.011830	0.171	0.767
323.8 - 290.1	305.0	0.000807	0.012636	0.106	0.873
290.1 - 245.5	263.9	0.001037	0.013673	0.157	1.030
245.5 - 220.9	231.8	0.000597	0.014270	0.103	1.133
220.9 - 201.1	210.0	0.000478	0.014748	0.091	1.224
201.1 - 183.8	191.6	0.000394	0.015142	0.082	1.306
183.8 - 167.2	174.7	0.000371	0.015513	0.085	1.391
167.2 - 148.6	156.7	0.000400	0.015913	0.102	1.493
148.6 - 127.5	136.3	0.000423	0.016336	0.124	1.618
127.5 - 114.8	120.4	0.000241	0.016577	0.080	1.698
114.8 - 104.5	109.1	0.000182	0.016760	0.067	1.765
104.5 - 89.6	95.8	0.000260	0.017020	0.109	1.873
89.6 - 79.4	83.8	0.000165	0.017185	0.079	1.952
79.4 - 71.2	74.8	0.000130	0.017315	0.070	2.022
71.2 - 64.4	67.4	0.000106	0.017421	0.063	2.085
64.4 - 58.7	61.2	0.000089	0.017510	0.058	2.143
58.7 - 53.8	56.0	0.000076	0.017587	0.055	2.198
53.8 - 49.6	51.5	0.000068	0.017655	0.053	2.250
49.6 - 45.9	47.6	0.000061	0.017716	0.052	2.302
45.9 - 42.6	44.1	0.000058	0.017774	0.052	2.354
42.6 - 39.7	41.1	0.000054	0.017828	0.053	2.407
39.7 - 37.1	38.3	0.000052	0.017881	0.055	2.462

TriStar 3000 V6.05 A

Unit 1 Port 1

Serial #: 1098

Page 10

Sample: CB6-17 minislab 05-0860 K4/K4
 Operator: MJP
 Submitter: Aberdeen Proving Ground
 File: C:\...\04APRIL\05-0860.SMP

Started: 4/20/2005 4:08:31PM	Analysis Adsorptive: N2
Completed: 4/21/2005 4:54:10AM	Analysis Bath Temp: 77.300 K
Report Time: 4/21/2005 7:33:54AM	Sample Mass: 3.9107 g
Warm Free Space: 7.6235 cm ³ Measured	Cold Free Space: 21.4787 cm ³ Measured
Equilibration Interval: 15 s	Low Pressure Dose: None
Sample Density: 1.000 g/cm ³	Automatic Degas: Yes

Sample Prep: Stage	Soak Temperature (°C)	Ramp Rate (°C/min)	Soak Time (min)			
1	110	10	960			
Pore Diameter Range (Å)	Average Diameter (Å)	Incremental Pore Volume (cm ³ /g)	Cumulative Pore Volume (cm ³ /g)	Incremental Pore Area (m ² /g)	Cumulative Pore Area (m ² /g)	
37.1 - 34.7	35.8	0.000050	0.017931	0.056	2.518	
34.7 - 32.5	33.5	0.000049	0.017979	0.058	2.576	
32.5 - 30.5	31.4	0.000047	0.018026	0.060	2.636	
30.5 - 28.8	29.6	0.000043	0.018069	0.058	2.694	
28.8 - 27.0	27.8	0.000045	0.018114	0.064	2.758	
27.0 - 25.3	26.1	0.000043	0.018157	0.065	2.823	
25.3 - 23.7	24.5	0.000041	0.018197	0.066	2.890	
23.7 - 22.2	22.9	0.000038	0.018236	0.067	2.957	
22.2 - 20.8	21.4	0.000036	0.018272	0.068	3.024	
20.8 - 19.4	20.0	0.000034	0.018306	0.067	3.092	
19.4 - 18.0	18.6	0.000032	0.018338	0.070	3.161	
18.0 - 16.5	17.2	0.000033	0.018371	0.077	3.238	

Sample: CB6-17 minislab 05-0860 K4/K4
 Operator: MJP
 Submitter: Aberdeen Proving Ground
 File: C:\...04APRIL05-0860.SMP

Started: 4/20/2005 4:08:31PM
 Completed: 4/21/2005 4:54:10AM
 Report Time: 4/21/2005 7:33:54AM
 Warm Free Space: 7.6235 cm³ Measured
 Equilibration Interval: 15 s
 Sample Density: 1.000 g/cm³

Analysis Adsorptive: N₂
 Analysis Bath Temp.: 77.300 K
 Sample Mass: 3.9107 g
 Cold Free Space: 21.4787 cm³ Measured
 Low Pressure Dose: None
 Automatic Degas: Yes

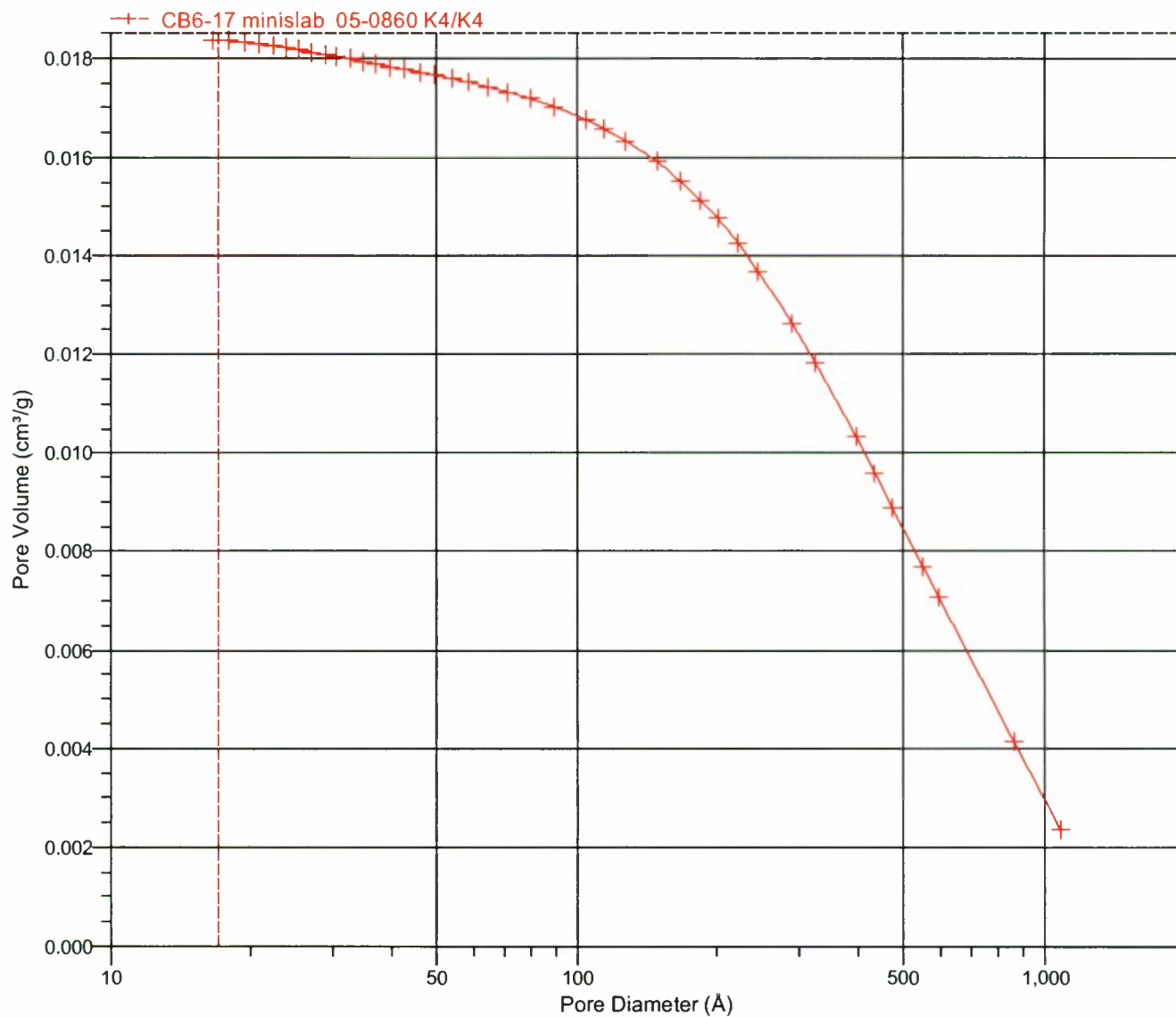
Sample Prep: Stage
 1

Soak Temperature (°C)
 110

Ramp Rate (°C/min)
 10

Soak Time (min)
 960

BJH Adsorption Cumulative Pore Volume



TriStar 3000 V6.05 A

Unit 1 Port 1

Serial #: 1098

Page 12

Sample: CB6-17 minislab 05-0860 K4/K4
 Operator: MJP
 Submitter: Aberdeen Proving Ground
 File: C:\...\04APRIL05-0860.SMP

Started: 4/20/2005 4:08:31PM
 Completed: 4/21/2005 4:54:10AM
 Report Time: 4/21/2005 7:33:54AM
 Warm Free Space: 7.6235 cm³ Measured
 Equilibration Interval: 15 s
 Sample Density: 1.000 g/cm³

Analysis Adsorptive: N2
 Analysis Bath Temp.: 77.300 K
 Sample Mass: 3.9107 g
 Cold Free Space: 21.4787 cm³ Measured
 Low Pressure Dose: None
 Automatic Degas: Yes

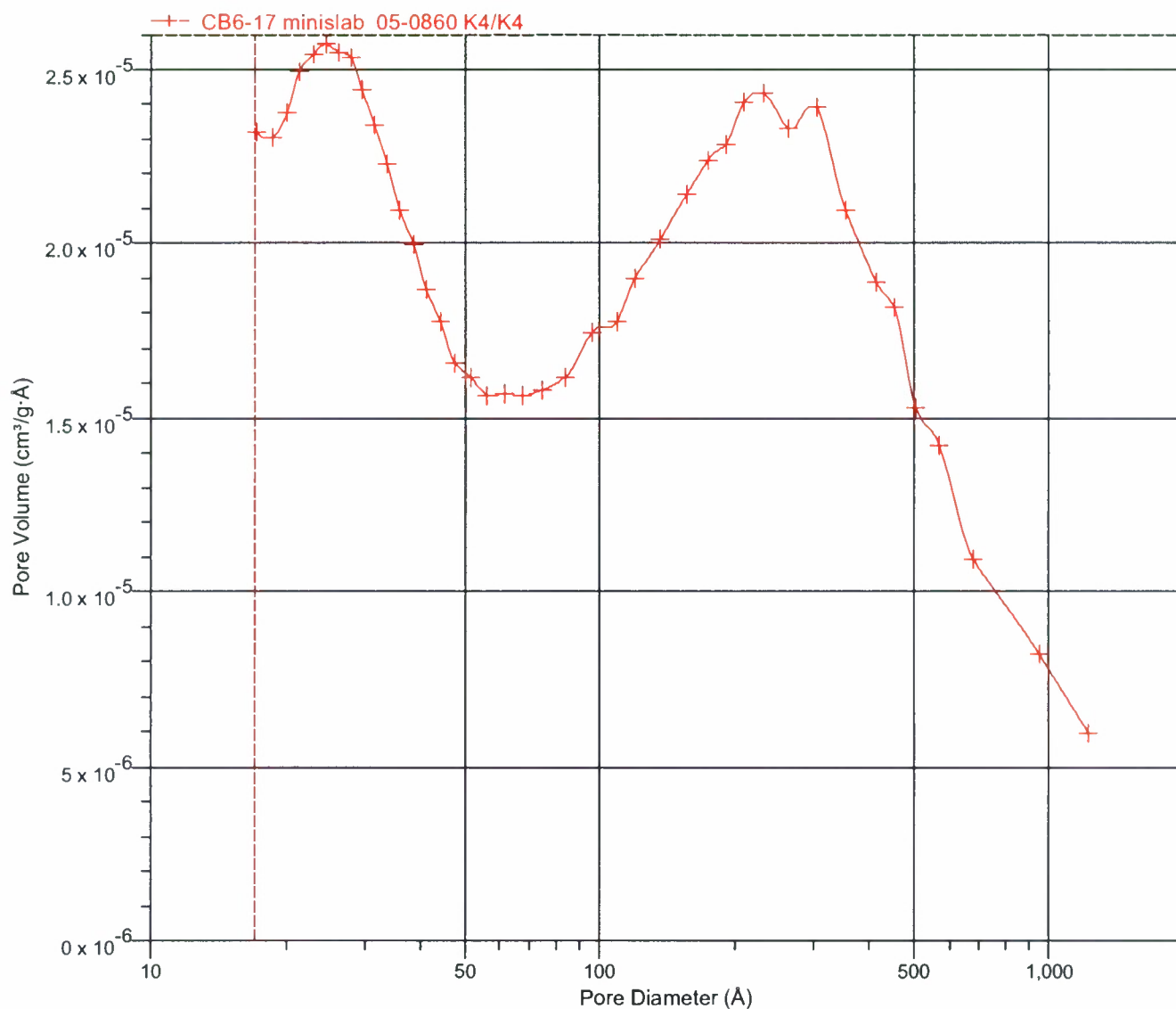
Sample Prep: Stage
 1

Soak Temperature (°C)
 110

Ramp Rate (°C/min)
 10

Soak Time (min)
 960

BJH Adsorption dV/dD Pore Volume



TriStar 3000 V6.05 A

Unit 1 Port 1

Serial #: 1098

Page 13

Sample: CB6-17 minislabs 05-0860 K4/K4
 Operator: MJP
 Submitter: Aberdeen Proving Ground
 File: C:\...04APRIL05-0860.SMP

Started: 4/20/2005 4:08:31PM
 Completed: 4/21/2005 4:54:10AM
 Report Time: 4/21/2005 7:33:54AM
 Warm Free Space: 7.6235 cm³ Measured
 Equilibration Interval: 15 s
 Sample Density: 1.000 g/cm³

Analysis Adsorptive: N₂
 Analysis Bath Temp.: 77.300 K
 Sample Mass: 3.9107 g
 Cold Free Space: 21.4787 cm³ Measured
 Low Pressure Dose: None
 Automatic Degas: Yes

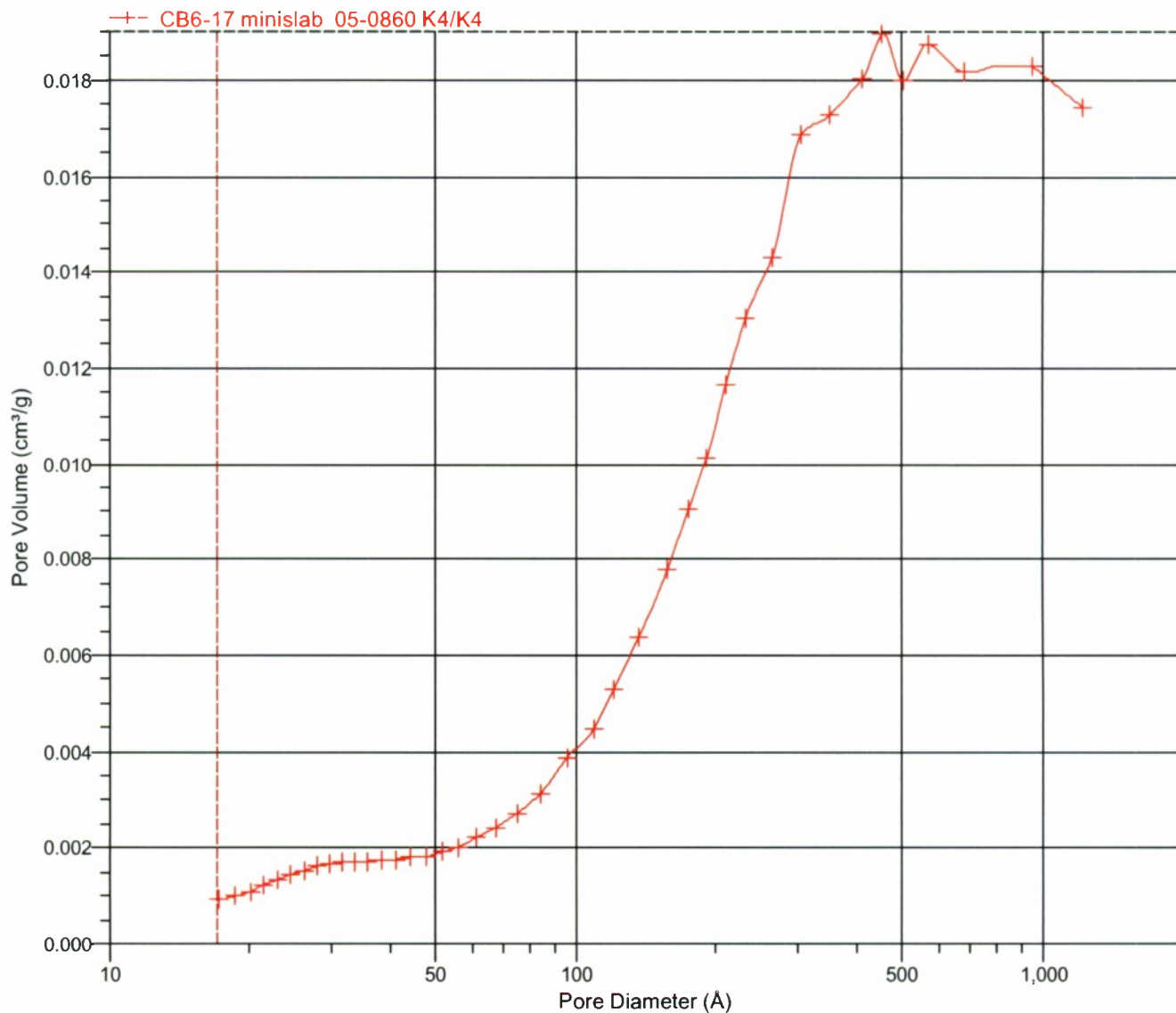
Sample Prep: Stage
 1

Soak Temperature (°C)
 110

Ramp Rate (°C/min)
 10

Soak Time (min)
 960

BJH Adsorption dV/dlog(D) Pore Volume



TriStar 3000 V6.05 A

Unit 1 Port 1

Serial #: 1098

Page 14

Sample: CB6-17 minislab 05-0860 K4/K4
 Operator: MJP
 Submitter: Aberdeen Proving Ground
 File: C:\...\04APRIL\05-0860.SMP

Started: 4/20/2005 4:08:31PM
 Completed: 4/21/2005 4:54:10AM
 Report Time: 4/21/2005 7:33:54AM
 Warm Free Space: 7.6235 cm³ Measured
 Equilibration Interval: 15 s
 Sample Density: 1.000 g/cm³

Analysis Adsorptive: N₂
 Analysis Bath Temp.: 77.300 K
 Sample Mass: 3.9107 g
 Cold Free Space: 21.4787 cm³ Measured
 Low Pressure Dose: None
 Automatic Degas: Yes

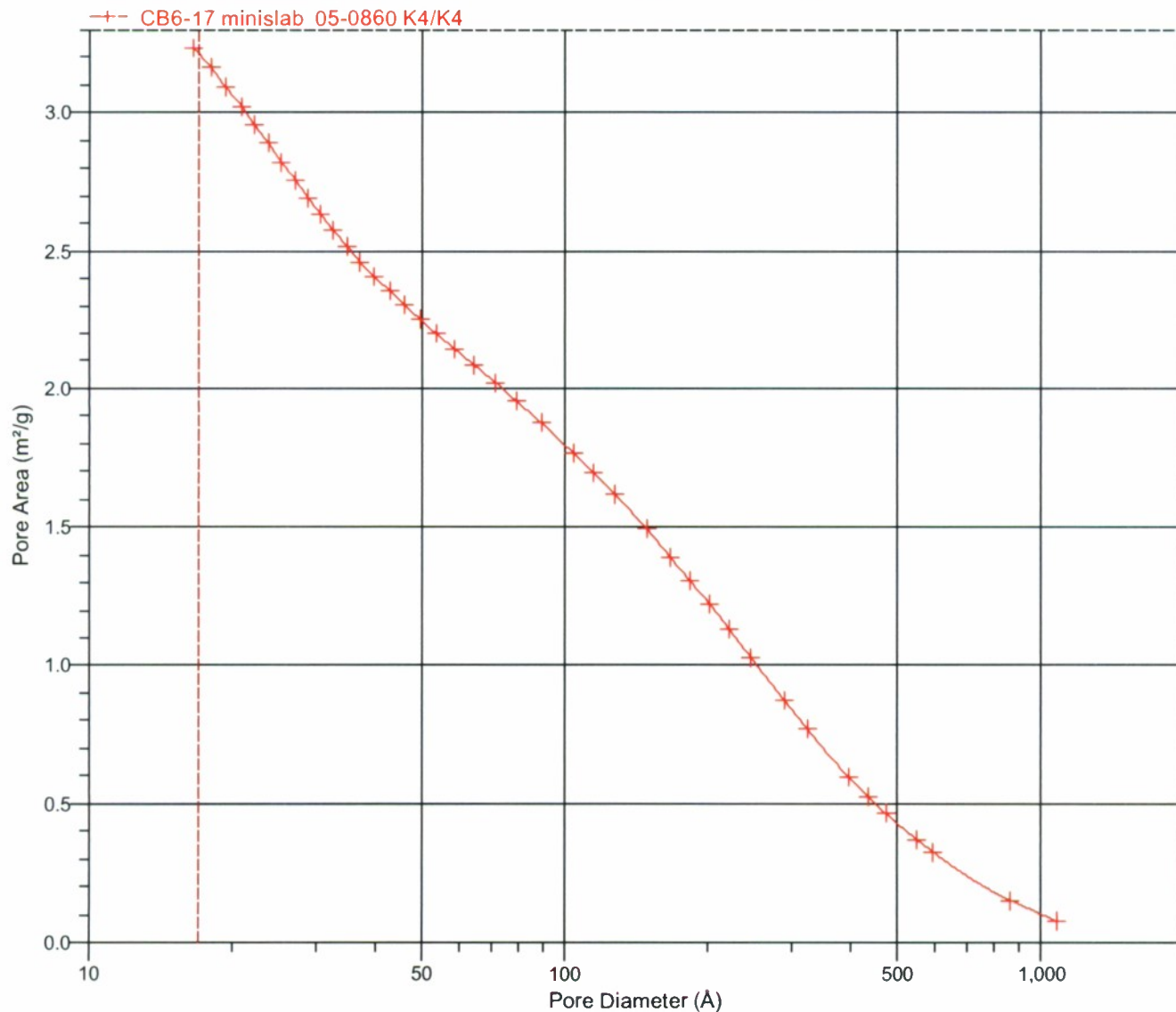
Sample Prep: Stage
 1

Soak Temperature (°C)
 110

Ramp Rate (°C/min)
 10

Soak Time (min)
 960

BJH Adsorption Cumulative Pore Area



Sample: CB6-17 minislab 05-0860 K4/K4
 Operator: MJP
 Submitter: Aberdeen Proving Ground
 File: C:\...104APRIL\05-0860.SMP

Started: 4/20/2005 4:08:31PM
 Completed: 4/21/2005 4:54:10AM
 Report Time: 4/21/2005 7:33:54AM
 Warm Free Space: 7.6235 cm³ Measured
 Equilibration Interval: 15 s
 Sample Density: 1.000 g/cm³

Analysis Adsorptive: N2
 Analysis Bath Temp.: 77.300 K
 Sample Mass: 3.9107 g
 Cold Free Space: 21.4787 cm³ Measured
 Low Pressure Dose: None
 Automatic Degas: Yes

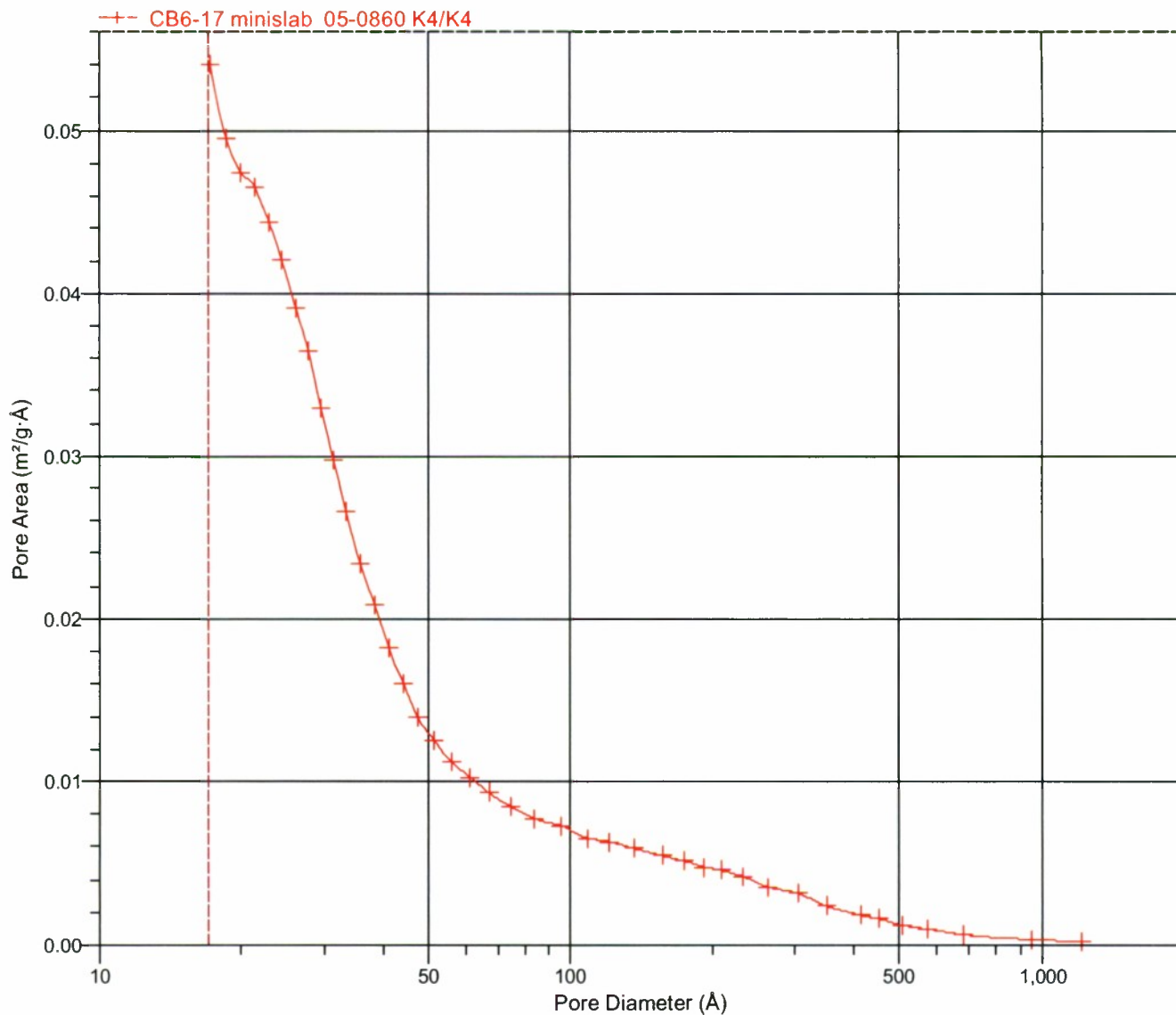
Sample Prep: Stage
 1

Soak Temperature (°C)
 110

Ramp Rate (°C/min)
 10

Soak Time (min)
 960

BJH Adsorption dA/dD Pore Area



TriStar 3000 V6.05 A

Unit 1 Port 1

Serial #: 1098

Page 16

Sample: CB6-17 minislab 05-0860 K4/K4
 Operator: MJP
 Submitter: Aberdeen Proving Ground
 File: C:\...\04APRIL\05-0860.SMP

Started: 4/20/2005 4:08:31PM
 Completed: 4/21/2005 4:54:10AM
 Report Time: 4/21/2005 7:33:54AM
 Warm Free Space: 7.6235 cm³ Measured
 Equilibration Interval: 15 s
 Sample Density: 1.000 g/cm³

Analysis Adsorptive: N2
 Analysis Bath Temp.: 77.300 K
 Sample Mass: 3.9107 g
 Cold Free Space: 21.4787 cm³ Measured
 Low Pressure Dose: None
 Automatic Degas: Yes

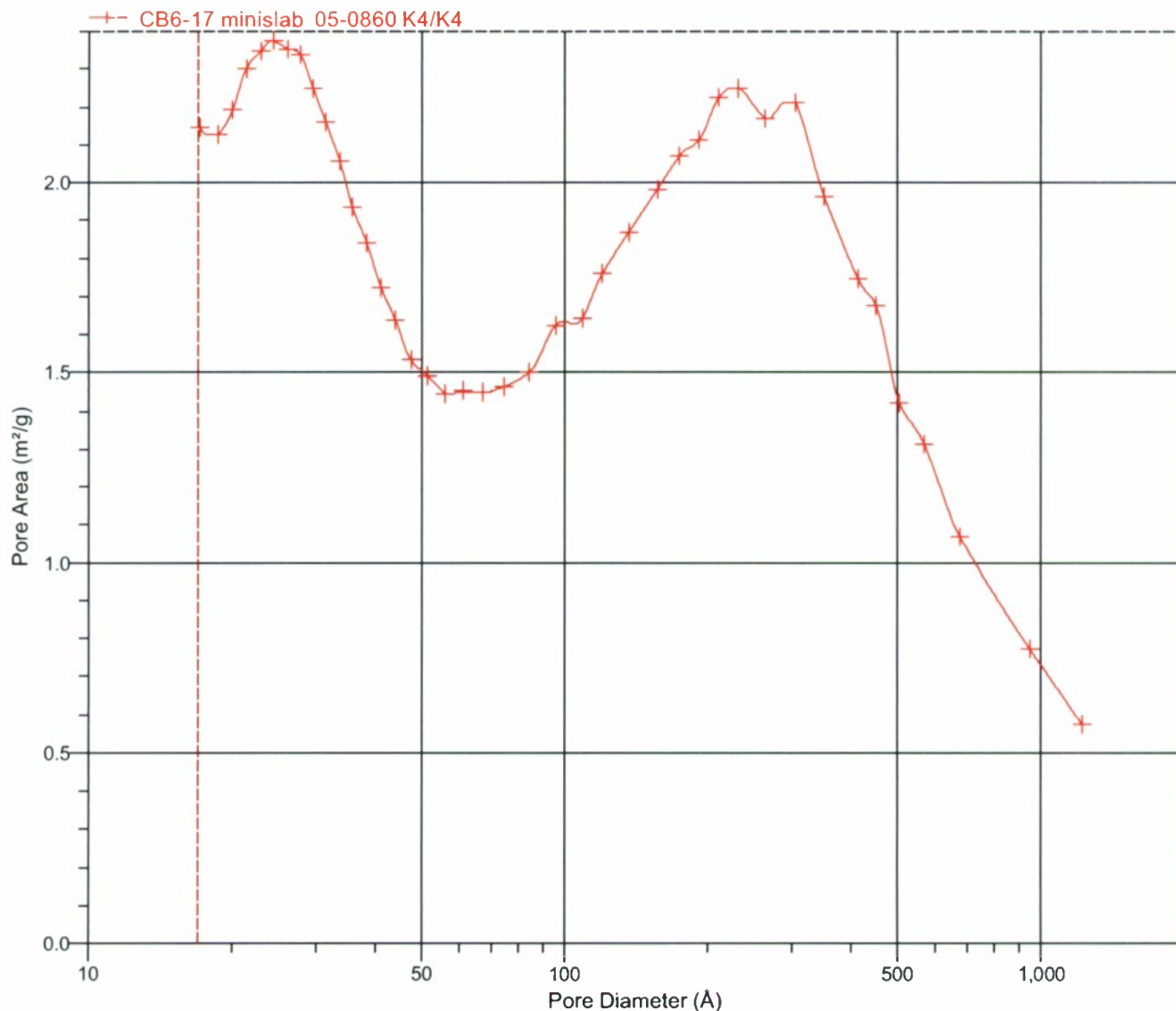
Sample Prep: Stage
 1

Soak Temperature (°C)
 110

Ramp Rate (°C/min)
 10

Soak Time (min)
 960

BJH Adsorption dA/dlog(D) Pore Area



TriStar 3000 V6.05 A

Unit 1 Port 1

Serial #: 1098

Page 17

Sample: CB6-17 minislabs 05-0860 K4/K4

Operator: MJP

Submitter: Aberdeen Proving Ground

File: C:\...04APRIL05-0860.SMP

Started: 4/20/2005 4:08:31PM	Analysis Adsorptive: N2
Completed: 4/21/2005 4:54:10AM	Analysis Bath Temp.: 77.300 K
Report Time: 4/21/2005 7:33:54AM	Sample Mass: 3.9107 g
Warm Free Space: 7.6235 cm ³ Measured	Cold Free Space: 21.4787 cm ³ Measured
Equilibration Interval: 15 s	Low Pressure Dose: None
Sample Density: 1.000 g/cm ³	Automatic Degas: Yes

Sample Prep: Stage	Soak Temperature (°C)	Ramp Rate (°C/min)	Soak Time (min)
1	110	10	960

Summary Report

Surface Area

Single point surface area at P/Po = 0.290614370: 2.9687 m²/g

BET Surface Area: 3.0351 m²/g

t-Plot Micropore Area: 0.2953 m²/g

t-Plot External Surface Area: 2.7399 m²/g

BJH Adsorption cumulative surface area of pores
 between 17.000 Å and 3000.000 Å diameter: 3.2382 m²/g

Pore Volume

Single point adsorption total pore volume of pores
 less than 2556.829 Å diameter at P/Po = 0.992391303: 0.022531 cm³/g

Single point desorption total pore volume of pores
 less than 3895.491 Å diameter at P/Po = 0.995029096: 0.026921 cm³/g

t-Plot micropore volume: 0.000137 cm³/g

BJH Adsorption cumulative volume of pores
 between 17.000 Å and 3000.000 Å diameter: 0.018371 cm³/g

Pore Size

Adsorption average pore width (4V/A by BET): 296.9365 Å

Desorption average pore width (4V/A by BET): 354.7930 Å

BJH Adsorption average pore diameter (4V/A): 226.925 Å

APPENDIX D

ENVIRONMENTAL FACTORS AND EVAPORATION RATES
FOR INDIVIDUAL EXPERIMENTS

APPENDIX D

ENVIRONMENTAL FACTORS AND EVAPORATION RATES FOR INDIVIDUAL EXPERIMENTS

Table D. Environmental Parameters for the Evaporation of H from CZ04 Concrete

code	surface ⁺	agent	temp /°C	H mass /mg	Air Flow /SLPM	%vapor rec'd	Raw evap rate /μg min ⁻¹	pred evap rate	log ₁₀ raw evap rate	pred log ₁₀ evap rate
3d067	NM	H	15.3	1.01	18.1	26.4	3.5	-9.9	0.54	0.49
3d065	NM	H	15.5	1.01	18.1	53.2	3.7	10	0.57	0.67
3d070	NM	H	15	1.01	404	58.9	14.1	9.7	1.15	0.97
3d069	NM	H	15.3	1.01	404	61.7	7.3	12.5	0.86	1.00
3d066	NM	H	15.2	1.01	405	56.1	5.2	8.0	0.72	0.96
3d075	NM	H	15	9.08	403	37.7	48.8	22	1.69	1.31
3d076	NM	H	14	9.08	405	26.4	16.1	9.4	1.21	1.22
3d060	NM	H	15.5	9.09	396	80.1	53	55	1.72	1.60
3d071	NM	H	15.3	9.09	405	48.5	6.9	31	0.84	1.39
3d063	NM	H	14.6	9.09	18.1	32.5	7.4	4.2	0.87	1.03
3d064	NM	H	14.8	9.09	18.1	59.6	22.5	25	1.35	1.21
3d072	NM	H	15.2	9.09	18.1	42.3	8.8	13	0.94	1.11
3d061	NM	H	14.8	9.09	19	27.8	9.6	1.1	0.98	1.00
3d059	NM	H	15.2	9.09	19	52.4	11	20	1.04	1.17
3a138	NM	H	34.6	6.06	180	58.5	40.1	67	1.60	1.57
3a129	NM	H	34.7	6.06	182	40.3	72.9	54	1.86	1.46
3a111	NM	H	34.8	6.06	182	39.8	104.4	54	2.02	1.46
3a134	NM	H	34.9	6.06	180	56.7	34.1	67	1.53	1.57
3a108	NM	H	34.9	6.06	182	18.5	38.3	38\	1.58	1.32
3a110	NM	H	35.1	6.06	182	49.4	58.6	62	1.77	1.53
3a137	NM	H	35.3	6.06	181	65.1	28.8	74	1.46	1.63
3c153	NM	H	35.5	6.06	181	33.6	89.5	51	1.95	1.43
3c152	NM	H	35.7	6.06	181	42.9	91.5	58	1.96	1.50
3c150	NM	H	35.4	6.06	181	30.2	3.9	48	0.59	1.41
3a118	NM	H	49.9	1.01	16.8	29.1	7	11	0.85	1.25
3a127	NM	H	49.9	1.01	18	62.1	16.9	35	1.23	1.47
3a121	NM	H	50	1.01	18	39	19.1	18	1.28	1.32
3a135	NM	H	48.3	1.01	18.2	84.6	49.2	52	1.69	1.58
3a136	NM	H	49.1	1.01	18	30.1	23.5	11	1.37	1.24
3a128	NM	H	49.4	1.01	18	70.9	48.6	42	1.69	1.51
3c173	NM	H	50.6	1.01	403	100.8	178	123	2.25	2.11
3c162	NM	H	50.5	1.01	404	88.2	142	114	2.15	2.03

Table D. Environmental Parameters for the Evaporation of H from CZ04 Concrete (cont'd.)

code	surface [†]	agent	temp /°C	H mass /mg	Air Flow /SLPM	% vapor rec'd	Raw evap rate /μg min ⁻¹	pred evap rate	log ₁₀ raw evap rate	pred log ₁₀ evap rate
3c159	NM	H	50.6	1.01	404	81.5	85.5	109	1.93	1.99
3c161	NM	H	49.6	1.01	405	93.7	64	116	1.81	2.05
3c172	NM	H	49.6	9.09	18.1	61.2	158.6	99	2.20	1.98
3c160	NM	H	49.6	9.09	18.5	23.6	24.9	70	1.40	1.74
3c170	NM	H	50.1	9.09	18	80.8	122	114	2.09	2.12
3c169	NM	H	50.2	9.09	18	86.9	121	119	2.08	2.16
3c163	NM	H	50.3	9.09	18	29.5	73.7	76	1.87	1.79
3c174	NM	H	50.8	9.09	18	61.2	108.3	101	2.03	2.01
3c175	NM	H	50	9.09	18.1	46.8	68.1	89	1.83	1.90
3a119	NM	H	50	9.09	405	64.1	225.1	177	2.35	2.36
3a120	NM	H	49.7	9.09	405	63.1	145.7	175	2.16	2.35
3a117	NM	H	49.8	9.09	405	53.7	146.2	169	2.16	2.29
3c151	NM	HD	35.8	7.54	182	30.1	90.3	58	1.96	1.51
3a109	NM	HD	34.8	7.54	182	27.4	15.4	55	1.19	1.47
3c149	NM	HD	35.4	7.54	181	15.3	23.3	46	1.37	1.40
3a107	NM	HD	35.1	7.54	182	11.8	31.2	43	1.49	1.37
3a122	R	H	51	1.01	18	49.3	2.6	26	0.41	1.41
3a123	R	H	50.1	1.01	18	42.3	4.9	21	0.69	1.34
3a124	R	H	50.3	1.01	18	57.6	2.5	32	0.40	1.45
3a125	RW	H	50.1	1.01	18	64.9	15.9	38	1.20	1.49
3d058	R	H	15.2	1.01	18.2	30.9	0.4	-6.6	-0.40	0.52
3c156	R	H	35.2	6.06	181	22.3	13	42	1.11	1.35
3a114	R	H	35.2	6.06	182	21.8	54.3	41	1.73	1.35
3c164	R	H	50	9.09	18	26.7	19.4	73	1.29	1.77
3c165	R	H	49.9	9.09	18	45	36	87	1.56	1.88
3c166	RW	H	50.6	9.09	18	45.6	73.9	89	1.87	1.90
3c167	RW	H	49.8	9.09	18	53.7	48.8	93	1.69	1.94

[†]The C04 concrete surfaces were: molded (NM), rippled (R) and rippled weathered (RW).

Blank

APPENDIX E
WIND TUNNEL DATA

Data Evaluation Grade: Modeling Grade

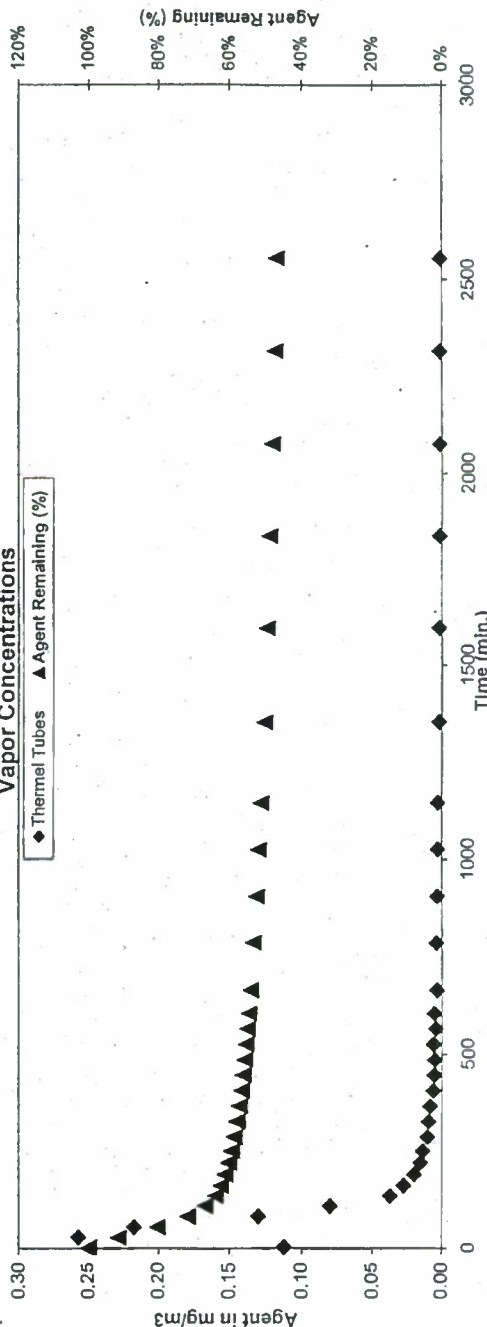
Tunnel: 3d		VTSS#7/GCMSD		09/28/06 67		Purity		78.2%	
Instruments:		Date/Experiment #:		Type of substrate :		Test agent/purity:		H	
Concrete(CZ04)		H		1		1 µL			
Number of drops:		1.29 mg		1.01 mg		15.25 °C		14.89 °C	
Nominal drop volume:		Corrected mass on 100% agent purity:		Average substrate temperature:		Average air temperature above drop:		Average air flow rate:	
		1.01 mg		15.25 °C		14.89 °C		18.06 SLPM	
		0.2		0.2		0.1		0.14 m/s	
		0.2		0.2		0.1		0.00 g/m^3	
		0.2		0.2		0.1		3.5 ug/min	
		0.2		0.2		0.1		26.4 %	
		0.2		0.2		0.1		n/a %	
		0.2		0.2		0.1		26.4 %	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2		0.1		Yes	
		0.2		0.2					

Data Evaluation Grade: Modeling Grade

Tunnel: 3d		VTS#7/GCMSD		09/25/06		65	
Instruments:		Concrete(CZ04)		H		Purity	
Date/Experiment #:		1		1		78.2%	
Type of substrate :		1		1			
Test agent/purity:		1		1			
Number of drops:		1		1			
Nominal drop volume:		1		1			
Mass of agent disseminated:		1.29 mg					
Corrected mass on 100% agent purity:		1.01 mg					
Average substrate temperature:		15.47 °C					
Average air temperature above drop:		14.99 °C					
Average air flow rate:		18.06 SLPm					
Test section air flow speed:		0.14 m/s					
Water vapor concentration:		0.00 g/m ³					
Crude Evap Rate:		3.7 ug/min					
Mass % recovery in vapor:		53.2 %					
Mass % recovery by extraction:		n/a %					
Total agent % mass recovery:		53.2 %					
Tube #s consistent:		Yes					
Daily CCV < +/- 15%:		Yes					

Data Evaluation		
SD	%SD	Status
0.2	1.10%	Go
0.2	1.60%	Go
0.1	0.28%	Go
-	-	Go

Vapor Concentrations



Time (min)	Conc. mg/m ³	HD rem. (%)
2.80	1.13E-01	99.72%
27.85	2.57E-01	91.43%
54.55	2.18E-01	80.09%
81.27	1.30E-01	71.78%
107.98	8.03E-02	66.75%
134.70	3.71E-02	63.95%
161.42	2.73E-02	62.41%
189.80	2.01E-02	61.20%
219.85	1.56E-02	60.24%
249.88	1.40E-02	59.45%
284.93	1.04E-02	58.69%
324.98	9.72E-03	57.97%
365.03	8.68E-03	57.31%
405.08	6.36E-03	56.77%
445.13	5.72E-03	56.34%
485.18	5.40E-03	55.94%
525.23	6.16E-03	55.52%
565.28	4.67E-03	55.14%
605.33	5.65E-03	54.77%
665.38	3.63E-03	54.27%
785.42	4.00E-03	53.45%
905.47	3.42E-03	52.65%
1025.52	3.15E-03	51.95%
1145.57	2.90E-03	51.30%
1355.62	2.04E-03	50.37%
1595.67	1.79E-03	49.55%
1835.72	1.56E-03	48.83%
2075.75	1.65E-03	48.14%
2315.80	1.55E-03	47.45%
2555.85	1.29E-03	46.84%

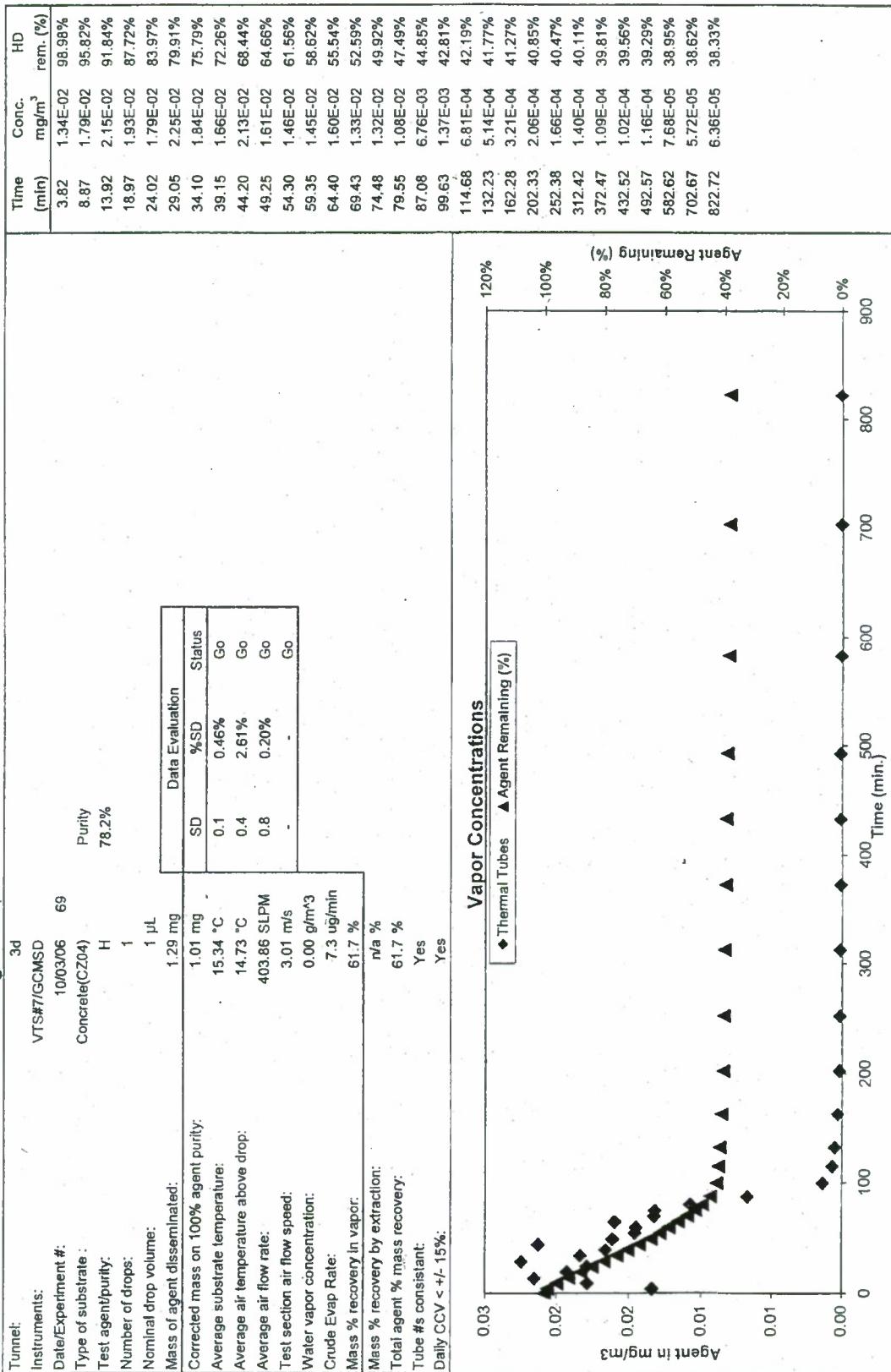
Data Evaluation Grade: Modeling Grade

Tunnel:		3d
Instruments:	VTS#7/GCM/SD	
Date/Experiment #:	10/04/06 70	
Type of substrate :	Concrete(CZ04)	Purity 78.2%
Test agent/purity:	H	
Number of drops:	1	
Nominal drop volume:	1 µL	
Mass of agent disseminated:	1.29 mg	
Corrected mass on 100% agent purity:	1.01 mg	
Average substrate temperature:	14.98 °C	Status Go
Average air temperature above drop:	14.75 °C	Go
Average air flow rate:	403.42 SLPM	Go
Test section air flow speed:	3.00 m/s	Go
Water vapor concentration:	0.00 g/m ³	
Crude Evap Rate:	14.1 ug/min	
Mass % recovery in vapor:	58.9 %	
Mass % recovery by extraction:	n/a %	
Total agent % mass recovery:	58.9 %	
Tube #'s constant:	Yes	
Daily CCV < +/- 15%:	Yes	

Time (min)	Conc. mg/m ³	HD rem. (%)
3.57	2.13E-02	98.48%
8.62	2.89E-02	93.42%
13.65	3.76E-02	86.72%
18.70	4.43E-02	78.46%
23.75	3.70E-02	70.27%
28.80	2.67E-02	63.84%
33.85	1.68E-02	59.46%
38.90	1.09E-02	56.66%
43.95	6.17E-03	54.93%
48.98	4.43E-03	53.87%
54.03	3.28E-03	53.09%
59.08	2.74E-03	52.48%
64.13	2.25E-03	51.98%
69.18	1.95E-03	51.56%
74.23	1.87E-03	51.17%
79.28	2.28E-03	50.75%
86.83	1.34E-03	50.20%
99.38	1.05E-03	49.60%
114.43	9.19E-04	49.01%
131.97	7.93E-04	48.41%
162.02	5.91E-04	47.58%
202.07	4.78E-04	46.72%
252.12	3.59E-04	45.88%
312.17	3.11E-04	45.08%
372.22	2.67E-04	44.39%
432.27	2.41E-04	43.78%
492.32	2.07E-04	43.24%
582.35	1.87E-04	42.53%
702.40	1.42E-04	41.74%
822.45	1.20E-04	41.12%

Vapor Concentrations

Data Evaluation Grade: Modeling Grade

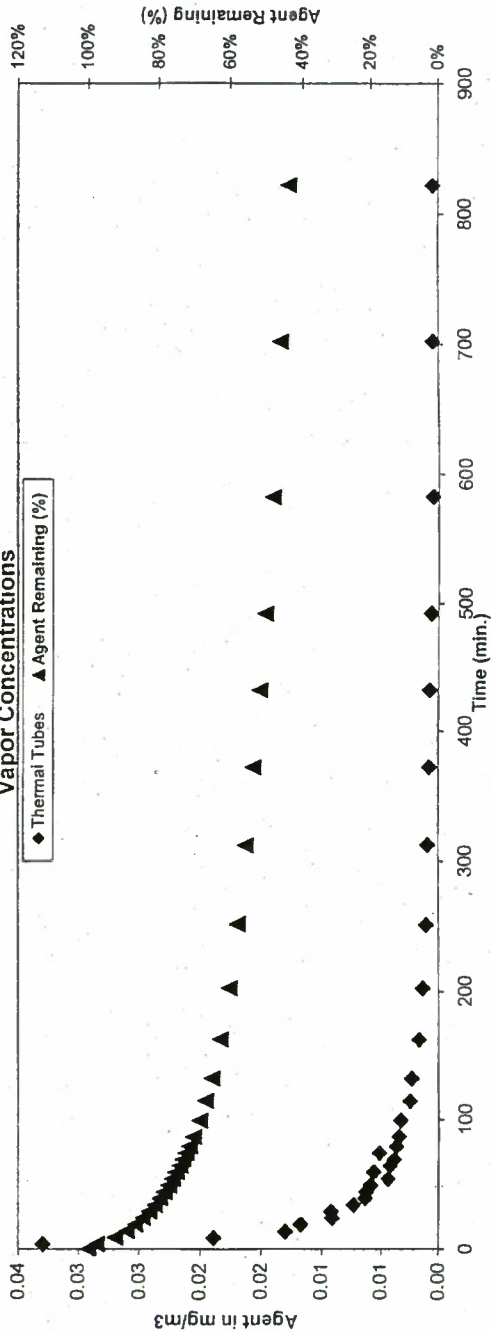


Data Evaluation Grade: Modeling Grade

Tunnel: 3d	
Instruments:	VTS#7/GCM5D
Date/Experiment #:	09/27/06 66
Type of substrate :	Concrete(CZ04)
Test agent/purity:	H 78.2%
Number of drops:	1
Nominal drop volume:	1 µL
Mass of agent disseminated:	1.29 mg
Corrected mass on 100% agent purity:	1.01 mg
Average substrate temperature:	15.24 °C
Average air temperature above drop:	14.87 °C
Average air flow rate:	404.84 SLPm
Test section air flow speed:	3.00 m/s
Water vapor concentration:	0.00 g/m³
Crude Evap Rate:	5.2 ug/min
Mass % recovery in vapor:	56.1 %
Mass % recovery by extraction:	n/a %
Total agent % mass recovery:	56.1 %
Tube #s consistent:	Yes
Daily CCV < +/- 15%:	Yes

Data Evaluation		
SD	%SD	Status
0.1	0.52%	Go
0.4	2.68%	Go
0.4	0.11%	Go
-	-	Go

Vapor Concentrations



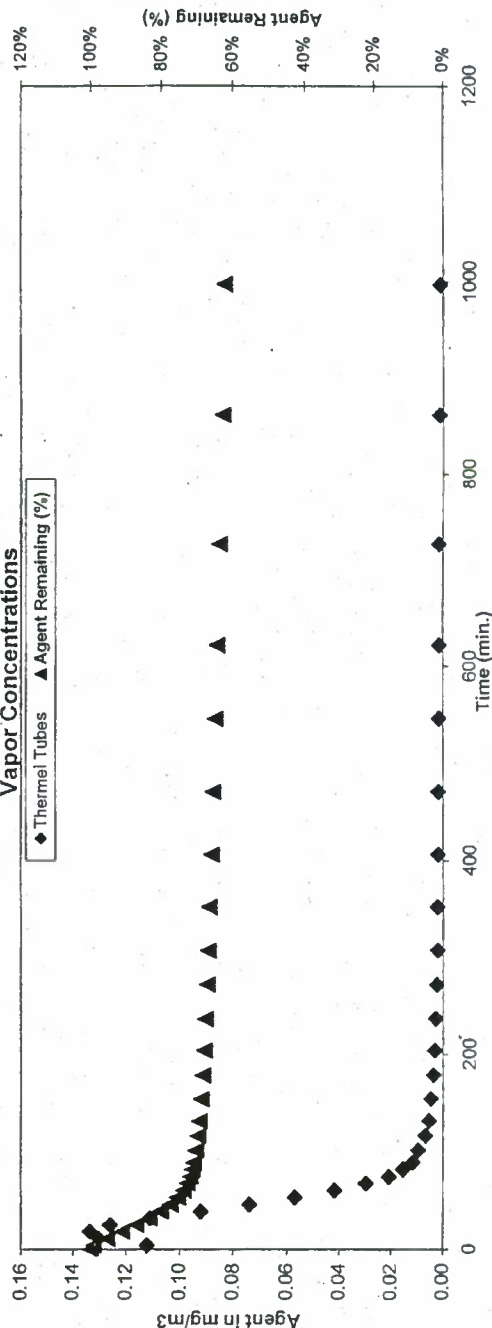
Time (min)	Conc. mg/m³	HD rem. (%)
3.57	3.30E-02	97.64%
8.62	1.89E-02	92.39%
13.67	1.30E-02	89.16%
18.72	1.18E-02	86.65%
23.77	9.14E-03	84.53%
28.82	9.23E-03	82.67%
33.87	7.32E-03	81.00%
38.92	6.35E-03	79.61%
43.95	6.24E-03	78.34%
49.00	5.87E-03	77.11%
54.05	4.37E-03	76.08%
59.10	5.62E-03	75.06%
64.15	4.20E-03	74.07%
69.20	3.84E-03	73.26%
74.25	5.13E-03	72.35%
79.30	3.63E-03	71.46%
86.85	3.41E-03	70.39%
99.40	3.26E-03	68.71%
114.45	2.48E-03	66.98%
131.98	2.30E-03	65.30%
162.03	1.62E-03	62.94%
202.08	1.37E-03	60.54%
252.13	1.04E-03	58.13%
312.18	8.88E-04	55.81%
372.23	7.66E-04	53.81%
432.28	7.54E-04	51.98%
492.32	6.26E-04	50.32%
582.37	4.71E-04	48.34%
702.42	4.60E-04	46.10%
822.47	4.52E-04	43.91%

Data Evaluation Grade: Modeling Grade

Tunnel: 3d	
Instruments:	VTS#07/GCMSD
Date/Experiment #:	01/08/07 75
Type of substrate :	Concrete(CZ)
Test agent/purity:	H 78.2% Purity
Number of drops:	1
Nominal drop volume:	9 µL
Mass of agent disseminated:	11.61 mg
Corrected mass on 100% agent purity:	9.08 mg
Average substrate temperature:	15.00 °C
Average air temperature above drop:	15.22 °C
Average air flow rate:	402.94 SLPM
Test section air flow speed:	2.98 m/s
Water vapor concentration:	0.00 g/m³
Crude Evap Rate:	48.8 ug/min
Mass % recovery in vapor:	37.7 %
Mass % recovery by extraction:	n/a %
Total agent % mass recovery:	37.7 %
Tube #s consistent:	Yes
Daily CCV < +/- 15%:	Yes

Data Evaluation		
SD	%SD	Status
0.2	1.49%	Go
0.2	1.26%	Go
1.0	0.25%	Go

Vapor Concentrations

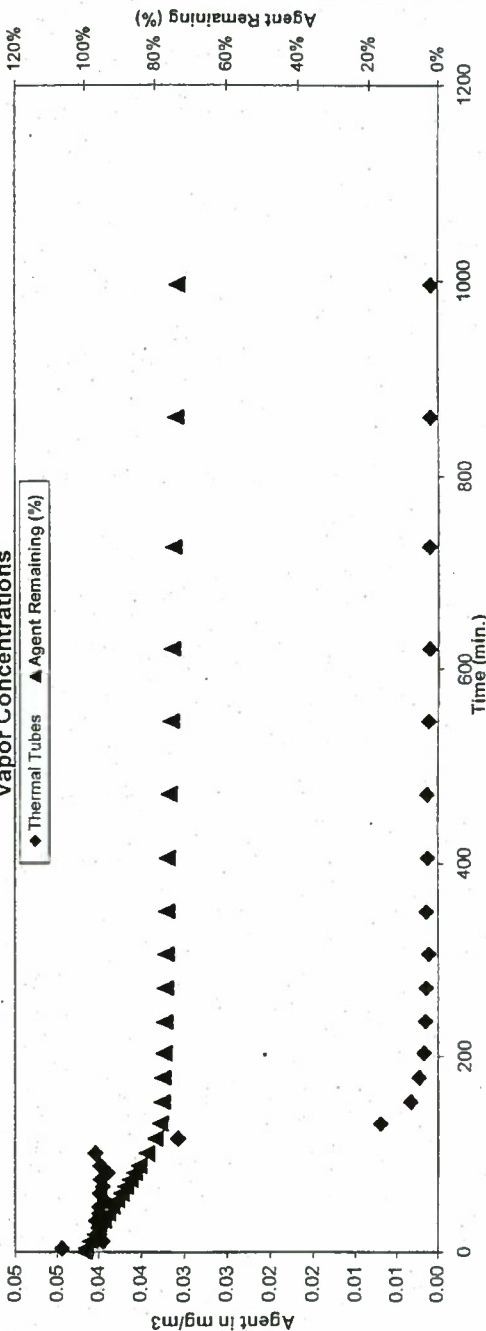


Time (min)	Conc. mg/m³	HD rem. (%)
3.90	1.12E-01	99.03%
10.95	1.30E-01	95.24%
18.00	1.34E-01	91.10%
25.05	1.26E-01	87.04%
32.10	1.11E-01	83.33%
39.13	9.21E-02	80.16%
46.18	7.38E-02	77.57%
53.23	5.71E-02	75.52%
60.28	4.17E-02	73.98%
67.33	2.97E-02	72.86%
74.38	2.09E-02	72.07%
81.43	1.53E-02	71.50%
88.47	1.15E-02	71.08%
101.02	9.44E-03	70.50%
116.07	6.78E-03	69.96%
131.12	5.35E-03	69.55%
153.67	4.61E-03	69.05%
178.72	3.70E-03	68.59%
203.77	3.08E-03	68.22%
236.32	2.80E-03	67.79%
271.37	2.42E-03	67.39%
306.42	2.05E-03	67.04%
351.45	2.17E-03	66.62%
406.50	1.93E-03	66.11%
471.55	1.84E-03	65.57%
546.60	1.59E-03	65.00%
621.65	1.50E-03	64.48%
726.70	1.42E-03	63.80%
861.75	1.25E-03	63.00%
996.80	1.08E-03	62.31%

Data Evaluation Grade: Modeling Grade

Tunnel: 3d		VTS#07/GCM5D		01/11/07 76	
Instruments:		Concrete(CZ04)		Purity 78.2%	
Date/Experiment #:		H		1	
Type of substrate :		9 µL		11.61 mg	
Test agent/purity:		Corrected mass on 100% agent purity:		9.08 mg	
Number of drops:		Average substrate temperature:		14.05 °C	
Nominal drop volume:		Average air temperature above drop:		15.40 °C	
Mass of agent disseminated:		Average air flow rate:		404.83 SLPM	
Corrected mass on 100% agent purity:		Test section air flow speed:		3.08 m/s	
Average substrate temperature:		Water vapor concentration:		0.00 g/m³	
Average air temperature above drop:		Crude Evap Rate:		16.1 ug/min	
Average air flow rate:		Mass % recovery in vapor:		26.4 %	
Test section air flow speed:		Mass % recovery by extraction:		n/a %	
Water vapor concentration:		Total agent % mass recovery:		26.4 %	
Crude Evap Rate:		Tube #s consistent:		Yes	
Mass % recovery in vapor:		Daily CCV < +/- 15%:		Yes	
Mass % recovery by extraction:					
Total agent % mass recovery:					
Tube #s consistent:					
Daily CCV < +/- 15%:					

Vapor Concentrations



Time (min)	Conc. mg/m³	HD rem. (%)
3.52	4.44E-02	99.65%
10.57	3.95E-02	98.33%
17.62	4.03E-02	97.08%
24.67	4.00E-02	95.82%
31.72	4.03E-02	94.55%
38.76	3.99E-02	93.29%
45.82	3.99E-02	92.04%
52.87	3.93E-02	90.79%
59.93	3.99E-02	89.55%
66.98	3.95E-02	88.30%
74.03	3.98E-02	87.05%
81.08	3.89E-02	85.82%
88.13	3.98E-02	84.58%
100.68	4.04E-02	82.34%
115.73	3.07E-02	79.95%
130.78	6.96E-03	78.69%
153.33	3.34E-03	78.17%
178.38	2.27E-03	77.86%
203.43	1.72E-03	77.53%
235.98	1.56E-03	77.39%
271.03	1.42E-03	77.16%
306.08	1.16E-03	76.96%
351.13	1.42E-03	76.70%
406.18	1.27E-03	76.37%
471.23	1.31E-03	76.00%
546.28	1.14E-03	75.59%
621.33	1.04E-03	75.23%
726.38	1.07E-03	74.73%
861.43	9.59E-04	74.12%
996.48	8.61E-04	73.57%

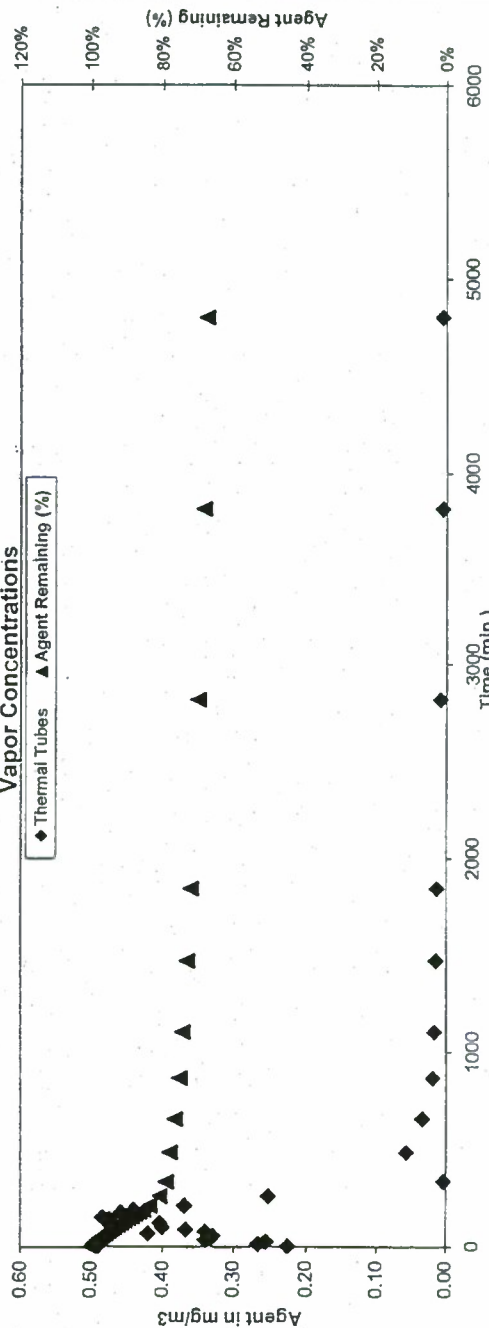
E-9

Data Evaluation Grade: Modeling Grade

Tunnel: 3d		VTS#7/GCMUSD		09/13/06 63	
Instruments:		Concrete(CZ04)		Purity 78.2%	
Date/Experiment #:		H		1	
Type of substrate :		9 µL			
Test agent/purity:		11.62 mg			
Number of drops:		9.09 mg			
Nominal drop volume:		14.56 °C			
Mass of agent disseminated:		15.13 °C			
Corrected mass on 100% agent purity:		18.06 SLPM			
Average substrate temperature:		0.14 m/s			
Average air temperature above drop:		0.00 g/m³			
Average air flow rate:		7.4 µg/min			
Test section air flow speed:		32.5 %			
Water vapor concentration:		n/a %			
Crude Evap Rate:		32.5 %			
Mass % recovery in vapor:		Yes			
Mass % recovery by extraction:		Yes			
Total agent % mass recovery:					
Tube #s consistent:					
Daily CCV < +/- 15%:					

Data Evaluation		
SD	%SD	Status
0.2	1.25%	Go
0.3	2.07%	Go
0.1	0.29%	Go
-	-	Go

Vapor Concentrations



Time (min)	Conc. mg/m³	HD rem. (%)
1.92	2.26E-01	99.96%
12.84	2.67E-01	99.42%
23.64	2.56E-01	98.86%
34.44	3.40E-01	98.22%
45.24	3.32E-01	97.50%
56.04	3.30E-01	96.79%
66.84	4.21E-01	95.98%
77.64	3.40E-01	95.17%
88.43	3.67E-01	94.41%
99.23	4.01E-01	93.58%
110.03	4.73E-01	92.65%
120.83	4.04E-01	91.71%
131.63	4.74E-01	90.76%
142.43	4.75E-01	89.74%
153.60	4.84E-01	88.68%
165.15	4.56E-01	87.60%
176.95	4.59E-01	86.53%
189.50	4.41E-01	85.40%
210.20	3.69E-01	83.74%
257.75	2.52E-01	80.80%
332.80	3.55E-03	78.89%
482.85	5.69E-02	77.99%
652.90	3.46E-02	76.44%
862.95	1.94E-02	75.32%
1103.00	1.70E-02	74.45%
1473.03	1.53E-02	73.26%
1843.08	1.35E-02	72.20%
2816.47	8.64E-03	70.05%
3809.85	5.66E-03	68.64%
4803.23	5.42E-03	67.55%

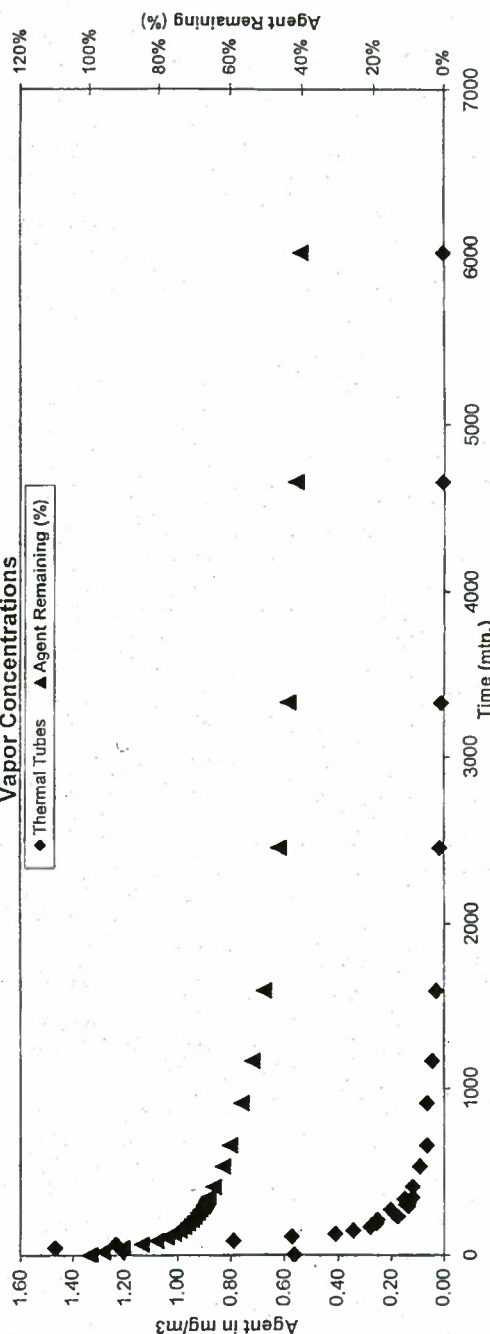
Data Evaluation Grade: Modeling Grade

Tunnel:		3d	
Instruments:	VTS#7/GCMSD		
Date/Experiment #:	09/20/06 64		
Type of substrate:	Concrete(CZ04)		
Test agent/purity:	H 78.2%		
Number of drops:	1		
Nominal drop volume:	9 µL		
Mass of agent disseminated:	11.62 mg		
Corrected mass on 100% agent purity:	9.09 mg		
Average substrate temperature:	14.78 °C		
Average air temperature above drop:	14.84 °C		
Average air flow rate:	18.06 SLPM		
Test section air flow speed:	0.14 m/s		
Water vapor concentration:	0.00 g/m³		
Crude Evap Rate:	22.5 ug/min		
Mass % recovery in vapor:	59.6 %		
Mass % recovery by extraction:	n/a %		
Total agent % mass recovery:	59.6 %		
Tube #'s consistent:	Yes		
Daily CCV < +/- 15%:	Yes		

Data Evaluation	
SD	%SD
0.6	4.12%
0.3	1.75%
0.0	0.27%
-	-
Status	
Go	Go
Go	Go
Go	Go
Go	Go

Time (min)	Conc. mg/m³	HD rem. (%)
1.63	5.63E-01	99.91%
22.54	1.21E+00	96.23%
43.34	1.47E+00	90.71%
64.14	1.23E+00	85.13%
84.94	7.89E-01	80.94%
105.74	5.70E-01	78.13%
126.54	4.12E-01	76.10%
147.34	3.44E-01	74.54%
168.12	2.80E-01	73.25%
188.92	2.57E-01	72.14%
209.72	2.54E-01	71.09%
230.52	1.77E-01	70.20%
251.32	1.94E-01	69.43%
272.13	2.04E-01	68.61%
292.93	1.38E-01	67.90%
303.73	1.47E-01	67.59%
314.53	1.35E-01	67.29%
325.32	1.42E-01	66.99%
336.12	1.51E-01	66.88%
347.28	1.21E-01	66.38%
408.83	1.21E-01	64.90%
530.63	9.43E-02	62.29%
654.18	6.64E-02	60.32%
909.23	6.68E-02	56.94%
1164.28	4.71E-02	54.05%
1591.00	3.12E-02	50.73%
2451.87	1.76E-02	46.56%
3325.25	1.16E-02	44.03%
4655.30	5.85E-03	41.72%
6025.35	3.66E-03	40.42%

Vapor Concentrations

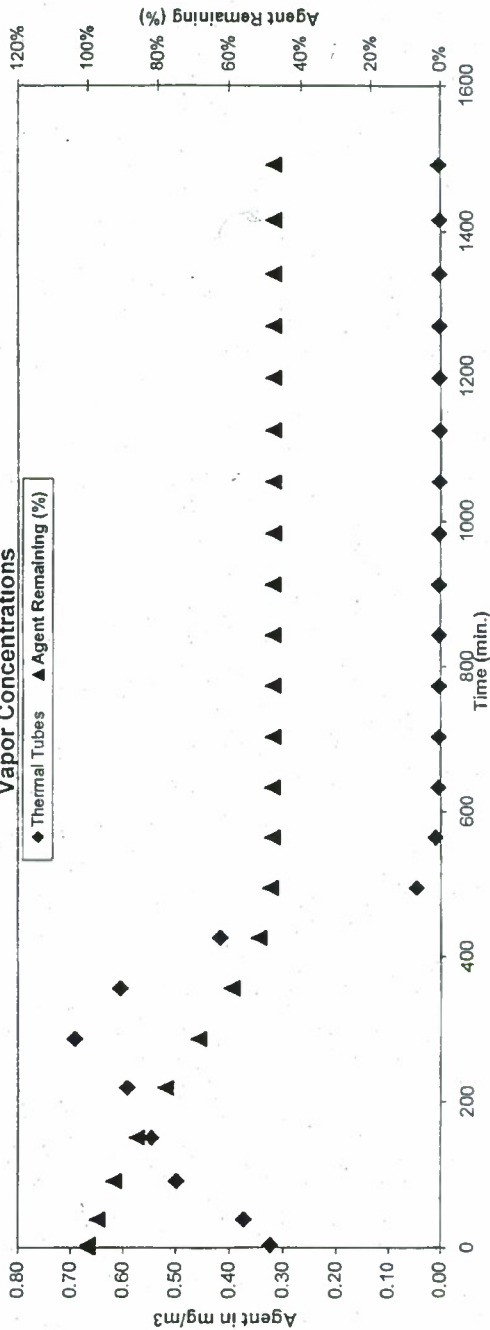


Data Evaluation Grade: Modeling Grade

Tunnel: 3d
 Instruments: VTS#7/GCMSD
 Date/Experiment #: 08/31/06 59
 Type of substrate : Concrete(CZ04)
 Test agent/purity: H 78.2%
 Number of drops: 1
 Nominal drop volume: 9 µL
 Mass of agent disseminated: 11.62 mg
 Corrected mass on 100% agent purity: 9.09 mg
 Average substrate temperature: 15.20 °C
 Average air temperature above drop: 15.63 °C
 Average air flow rate: 19.02 SLPM
 Test section air flow speed: 0.18 m/s
 Water vapor concentration: 0.00 g/m³
 Crude Evap Rate: 11.0 ug/min
 Mass % recovery in vapor: 52.4 %
 Mass % recovery by extraction: n/a %
 Total agent % mass recovery: 52.4 %
 Tube #s constant: Yes
 Daily CCV < +/- 15%: Yes

Data Evaluation		
SD	%SD	Status
0.3	1.77%	Go
0.8	5.01%	Go
1.2	6.20%	Go

Vapor Concentrations



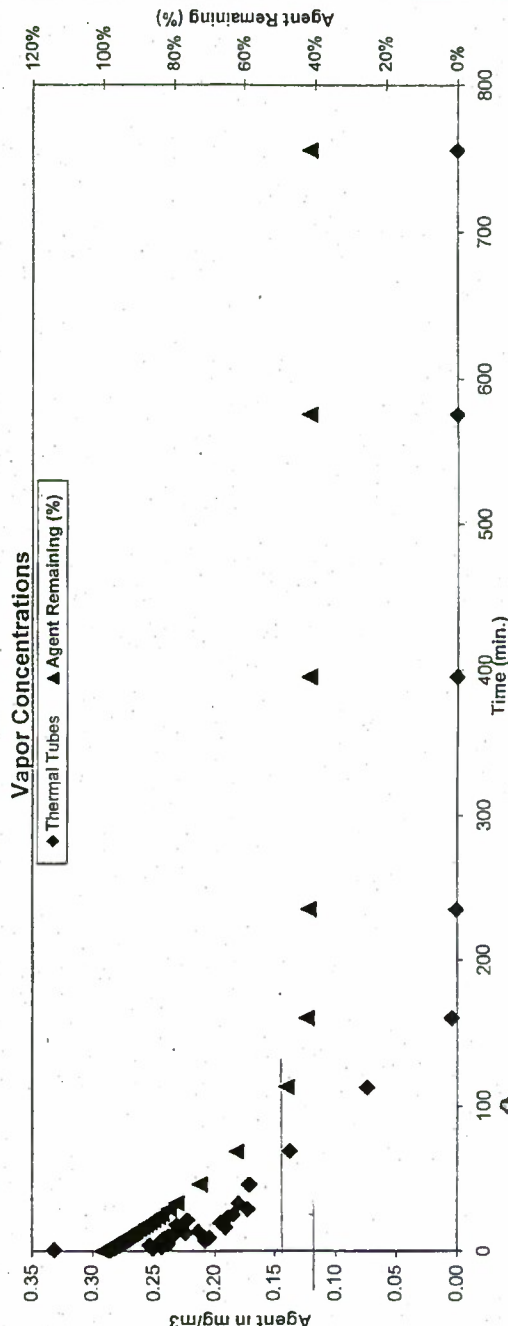
Time (min)	Conc. mg/m ³	HD rem. (%)
3.10	3.24E-01	99.89%
38.47	3.74E-01	97.31%
90.52	4.99E-01	92.56%
150.90	5.46E-01	85.96%
219.62	5.92E-01	77.78%
288.33	6.92E-01	68.54%
357.05	6.05E-01	59.22%
425.77	4.18E-01	51.86%
494.47	4.65E-02	48.52%
563.68	9.56E-03	48.12%
633.40	4.33E-03	48.02%
703.12	3.36E-03	47.95%
772.83	2.92E-03	47.92%
842.55	2.51E-03	47.88%
912.27	2.40E-03	47.84%
982.98	2.02E-03	47.81%
1054.70	2.14E-03	47.78%
1126.42	1.65E-03	47.75%
1198.12	1.98E-03	47.72%
1269.83	1.88E-03	47.69%
1341.55	2.09E-03	47.66%
1415.77	1.52E-03	47.63%
1492.48	2.75E-03	47.60%
0.00	0.00E+00	0.00%
0.00	0.00E+00	0.00%
0.00	0.00E+00	0.00%
0.00	0.00E+00	0.00%
0.00	0.00E+00	0.00%
0.00	0.00E+00	0.00%
0.00	0.00E+00	0.00%
0.00	0.00E+00	0.00%

Data Evaluation Grade: Modeling Grade

Tunnel: 3a		VTS#8/GCMSD	
Instruments:		Date/Experiment #:	10/02/06 138
Type of substrate:	Concrete(CZ04)	Purity	78.2%
Test agent/purity:	H		
Number of drops:	1		
Nominal drop volume:	6 µL		
Mass of agent disseminated:	7.75 mg		
Corrected mass on 100% agent purity:	6.06 mg		
Average substrate temperature:	34.59 °C		
Average air temperature above drop:	35.15 °C		
Average air flow rate:	180.09 SLPM		
Test section air flow speed:	1.80 m/s		
Water vapor concentration:	12.04 g/m ³		
Crude Evap Rate:	40.1 ug/min		
Mass % recovery in vapor:	58.5 %		
Mass % recovery by extraction:	n/a %		
Total agent % mass recovery:	58.5 %		
Tube #'s consistent:	Yes		
Daily CCV < +/- 15%:	Yes		

Data Evaluation		
SD	%SD	Status
0.1	0.24%	Go
0.2	0.52%	Go
1.7	0.96%	Go

Time (min)	Conc. mg/m ³	HD rem. (%)
0.55	3.32E-01	99.73%
1.60	2.51E-01	98.82%
2.65	2.43E-01	98.05%
3.70	2.53E-01	97.27%
4.75	2.38E-01	96.51%
5.80	2.45E-01	95.75%
6.85	2.08E-01	95.05%
7.90	2.42E-01	94.34%
8.95	2.05E-01	93.65%
10.00	2.38E-01	92.96%
11.05	2.33E-01	92.22%
12.08	2.24E-01	91.52%
13.13	2.14E-01	90.84%
14.68	2.29E-01	89.82%
16.23	1.91E-01	88.85%
17.78	2.31E-01	87.88%
19.33	1.95E-01	86.89%
21.13	2.22E-01	85.78%
23.18	1.89E-01	84.52%
25.23	1.84E-01	83.39%
29.03	1.72E-01	81.37%
33.08	1.80E-01	79.26%
45.63	1.71E-01	72.72%
68.68	1.38E-01	62.14%
112.72	7.45E-02	48.22%
160.27	4.45E-03	42.64%
235.32	7.16E-04	42.07%
395.37	3.78E-04	41.81%
575.42	2.39E-04	41.64%
755.47	2.19E-04	41.52%



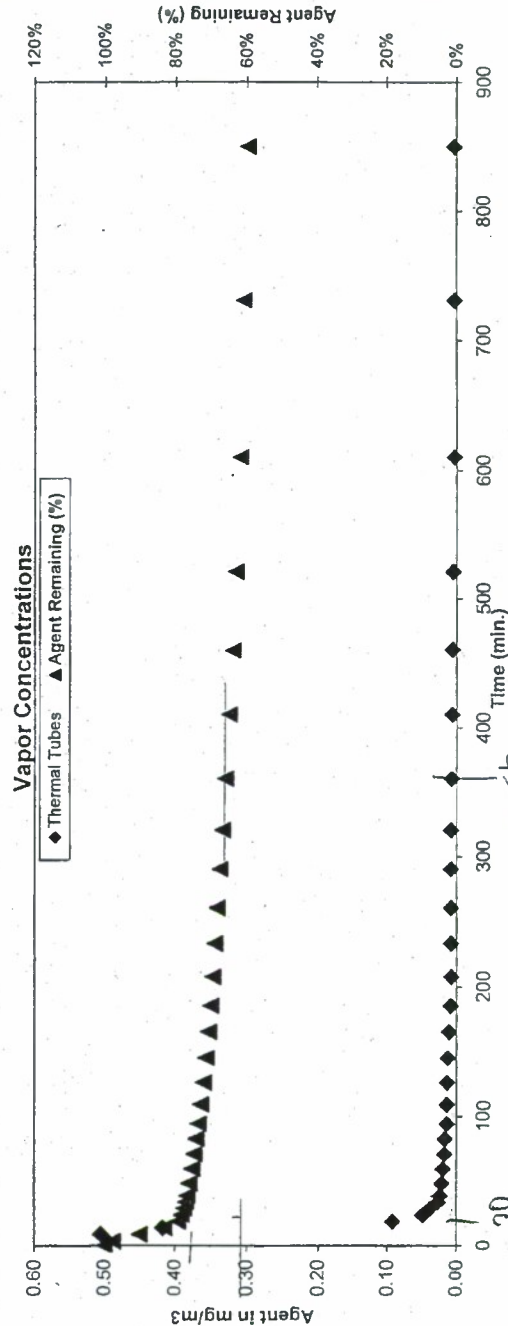
Data Evaluation Grade: Modeling Grade

Tunnel: 3a		VTS#2/GCMUSD		09/07/06		129	
Instruments:		Concrete(CZ04)		H		1	
Date/Experiment #:		Concrete(CZ04)		H		1	
Type of substrate :		Concrete(CZ04)		H		1	
Test agent/purity:		Concrete(CZ04)		H		1	
Number of drops:		Concrete(CZ04)		H		1	
Nominal drop volume:		Concrete(CZ04)		H		1	
Mass of agent disseminated:		Concrete(CZ04)		H		1	
Corrected mass on 100% agent purity:		Concrete(CZ04)		H		1	
Average substrate temperature:		Concrete(CZ04)		H		1	
Average air temperature above drop:		Concrete(CZ04)		H		1	
Average air flow rate:		Concrete(CZ04)		H		1	
Test section air flow speed:		Concrete(CZ04)		H		1	
Water vapor concentration:		Concrete(CZ04)		H		1	
Crude Evap Rate:		Concrete(CZ04)		H		1	
Mass % recovery in vapor:		Concrete(CZ04)		H		1	
Mass % recovery by extraction:		Concrete(CZ04)		H		1	
Total agent % mass recovery:		Concrete(CZ04)		H		1	
Tube #s consistent:		Concrete(CZ04)		H		1	
Daily CCV < +/- 15%:		Concrete(CZ04)		H		1	

Data Evaluation		Status	
SD	%SD	SD	%SD
0.1	0.17%	Go	Go
0.1	0.28%	Go	Go
1.7	0.91%	Go	Go
-	-	Go	Go

Corrected mass on 100% agent purity:	6.06 mg
Average substrate temperature:	34.73 °C
Average air temperature above drop:	35.02 °C
Average air flow rate:	181.92 SLPM
Test section air flow speed:	1.71 m/s
Water vapor concentration:	11.61 g/m ³
Crude Evap Rate:	72.9 ug/min
Mass % recovery in vapor:	40.3 %
Mass % recovery by extraction:	n/a %
Total agent % mass recovery:	40.3 %
Tube #s consistent:	Yes
Daily CCV < +/- 15%:	Yes

Time (min)	Conc. mg/m ³	HD rem. (%)
3.27	4.96E-01	97.57%
8.30	5.06E-01	90.00%
13.35	4.18E-01	83.00%
18.40	9.25E-02	79.13%
23.45	4.87E-02	78.06%
28.50	3.78E-02	77.41%
33.55	2.64E-02	76.92%
38.60	2.35E-02	76.54%
47.90	2.11E-02	75.92%
59.12	1.93E-02	75.24%
70.58	1.71E-02	74.61%
82.28	1.65E-02	74.02%
94.00	1.39E-02	73.48%
109.05	1.39E-02	72.85%
125.77	1.36E-02	72.16%
144.98	1.24E-02	71.41%
165.03	1.06E-02	70.72%
185.08	8.53E-03	70.15%
207.63	7.71E-03	69.60%
232.68	7.97E-03	69.01%
260.23	8.21E-03	68.34%
290.28	7.93E-03	67.61%
320.33	8.21E-03	66.88%
360.38	7.35E-03	65.94%
410.43	6.17E-03	64.93%
460.47	5.69E-03	64.04%
520.52	4.90E-03	63.08%
610.57	3.33E-03	61.97%
730.62	2.92E-03	60.84%
850.67	3.25E-03	59.73%



Data Evaluation Grade: 3a Test Grade (requires further evaluation)

Tunnel: 3a		VTS#2/GCMSD		111	
Instruments:		08/01/06		Concrete(CZ04)	
Date/Experiment #:		H		Purity 78.2%	
Type of substrate :		1			
Test agent/purity:		6 µL			
Number of drops:		7.75 mg			
Nominal drop volume:					
Mass of agent disseminated:					
Corrected mass on 100% agent purity:					
Average substrate temperature:					
Average air temperature above drop:					
Average air flow rate:					
Test section air flow speed:					
Water vapor concentration:					
Crude Evap Rate:					
Mass % recovery in vapor:					
Mass % recovery by extraction:					
Total agent % mass recovery:					
Tube #s consistent:					
Daily CCV < +/- 15%:					

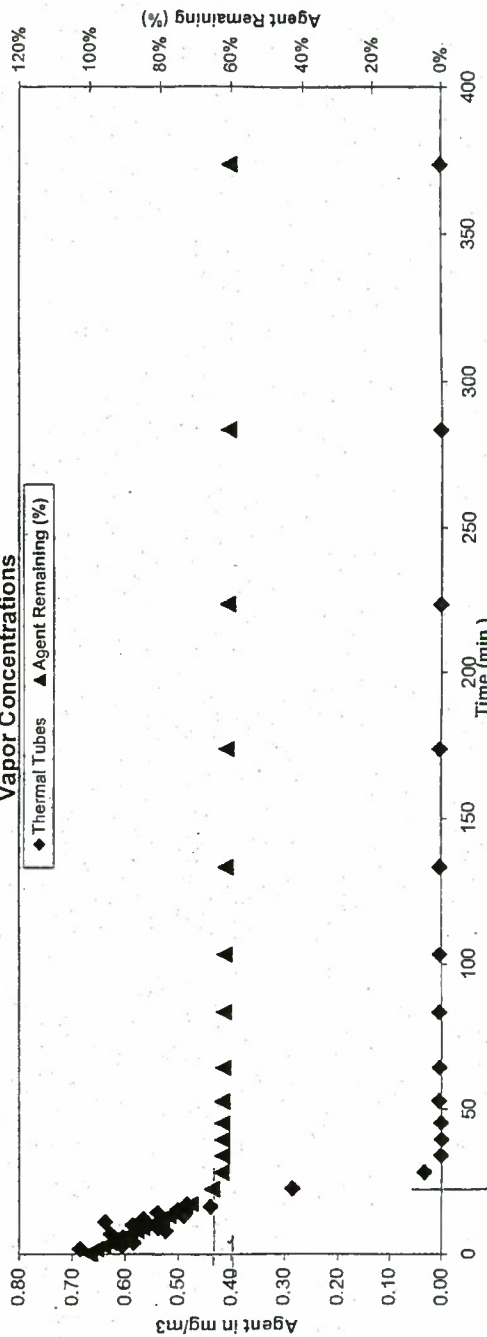
Data Evaluation		
SD	%SD	Status
0.2	0.50%	Go
0.2	0.51%	Go
3.0	1.63%	Flag
-	-	Go

Time (min)	Conc. mg/m³	HD rem. (%)
1.77	6.85E-01	98.18%
2.82	6.06E-01	96.15%
3.87	5.84E-01	94.27%
4.92	6.11E-01	92.39%
5.95	6.03E-01	90.51%
7.00	6.27E-01	88.57%
8.05	5.23E-01	86.75%
9.12	5.38E-01	85.05%
10.17	5.86E-01	83.28%
11.22	6.38E-01	81.35%
12.27	5.65E-01	79.46%
13.32	4.90E-01	77.79%
14.37	5.39E-01	76.17%
15.40	5.01E-01	74.56%
16.45	4.39E-01	73.07%
17.52	4.84E-01	71.60%
22.82	2.85E-01	65.48%
28.35	3.30E-02	62.84%
33.90	1.06E-03	62.55%
39.45	0.00E+00	62.54%
45.25	1.01E-03	62.53%
52.80	4.70E-03	62.47%
64.35	3.99E-03	62.32%
83.40	4.36E-03	62.08%
103.45	3.55E-03	61.84%
133.50	2.68E-03	61.56%
173.55	2.48E-03	61.25%
223.58	1.50E-03	60.95%
283.63	1.72E-03	60.66%
373.68	1.44E-03	60.23%

Vapor Concentrations

Time (min.)	Thermal Tubes (mg/m³)	Agent Remaining (mg/m³)
10	0.70	
20	0.68	
30	0.65	
40	0.62	
50	0.60	
60	0.58	
70	0.55	
80	0.52	
90	0.50	
100	0.48	0.40
110	0.45	0.40
120	0.42	0.40
130	0.40	0.40
140	0.38	0.40
150	0.35	0.40
160	0.32	0.40
170	0.30	0.40
180	0.28	0.40
190	0.25	0.40
200	0.22	0.40
210	0.20	0.40
220	0.18	0.40
230	0.15	0.40
240	0.12	0.40
250	0.10	0.40
260	0.08	0.40
270	0.05	0.40
280	0.02	0.40
290	0.00	0.40
300		0.40
310		0.40
320		0.40
330		0.40
340		0.40
350		0.40
360		0.40
370		0.40
380		0.40
390		0.40
400		0.40

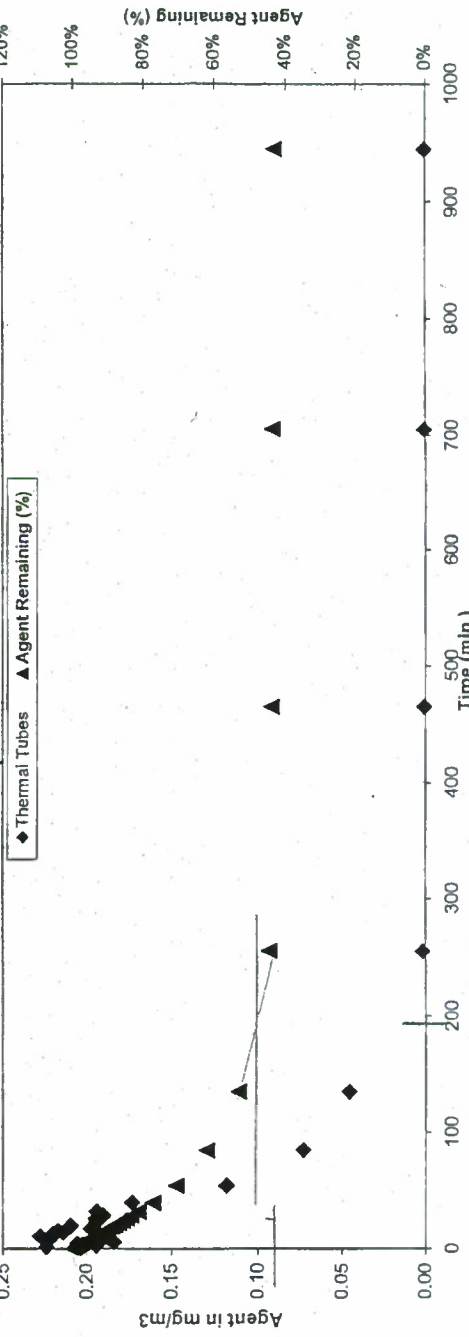
Vapor Concentrations



Data Evaluation Grade: Modeling Grade

Tunnel: 3a		VTS#8/GCMUSD		09/21/06 134	
Instruments:		Concrete(CZ04)		Purity	
Date/Experiment #:		H		78.2%	
Type of substrate:		1			
Test agent/purity:		6 µL			
Number of drops:		7.75 mg			
Nominal drop volume:		6.06 mg			
Mass of agent disseminated:		34.95 °C			
Corrected mass on 100% agent purity:		35.02 °C			
Average substrate temperature:		180.10 SLPM			
Average air temperature above drop:		1.71 m/s			
Average air flow rate:		12.07 g/m³			
Test section air flow speed:		34.1 ug/min			
Water vapor concentration:		56.7 %			
Crude Evap Rate:		n/a %			
Mass % recovery in vapor:		56.7 %			
Mass % recovery by extraction:		Yes			
Total agent % mass recovery:		Yes			
Tube #s consistent:					
Daily COV < +/- 15%:					

Vapor Concentrations



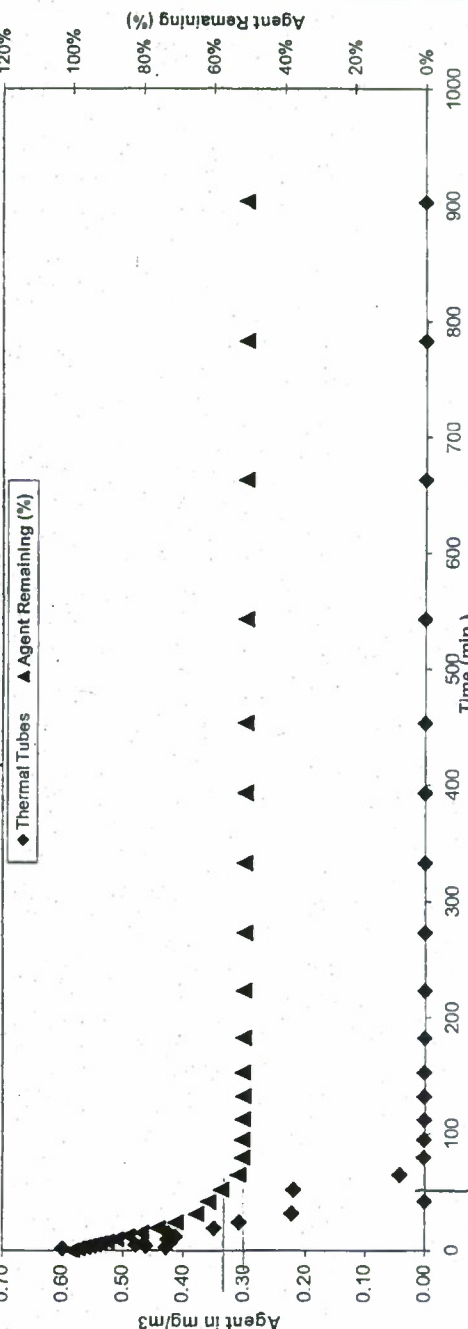
Data Evaluation Grade: **Test Grade (requires further evaluation)**

Tunnel:		3e	
Instruments:	VTS#2/GCMSD		
Date/Experiment #:	07/26/06	110	
Type of substrate :	Concrete(CZ04)		Purity
Test agent/purity:	H		78.2%
Number of drops:	1		
Nominal drop volume:	6 µL		
Mass of agent disseminated:	7.75 mg		
Corrected mass on 100% agent purity:	6.06 mg		
Average substrate temperature:	35.10 °C		
Average air temperature above drop:	35.25 °C		
Average air flow rate:	181.83 SLPM		
Test section air flow speed:	1.69 m/s		
Water vapor concentration:	14.74 g/m³		
Crude Evap Rate:	58.6 ug/min		
Mass % recovery in vapor:	49.4 %		
Mass % recovery by extraction:	n/a %		
Total agent % mass recovery:	49.4 %		
Tube #s consistent:	Yes		
Daily CCV < +/- 15%:	Yes		

Data Evaluation	
SD	%SD
0.2	0.55%
0.2	0.68%
2.7	1.47%
Status	
Go	
Go	
Flag	
Go	

Time (min)	Conc. mg/m³	HD rem. (%)
1.87	5.99E-01	98.32%
2.93	4.28E-01	96.68%
4.00	4.62E-01	95.25%
5.07	4.78E-01	93.75%
6.13	4.65E-01	92.24%
7.70	4.20E-01	90.15%
9.77	4.25E-01	87.53%
12.33	4.13E-01	84.30%
15.40	4.25E-01	80.44%
19.45	3.49E-01	75.74%
24.52	3.08E-01	70.74%
32.08	2.23E-01	64.71%
42.15	3.51E-04	61.34%
52.22	2.20E-01	58.01%
64.78	4.26E-02	53.05%
79.85	2.33E-03	52.04%
94.92	1.59E-03	51.95%
112.48	1.38E-03	51.87%
132.55	1.19E-03	51.79%
152.62	1.13E-03	51.72%
182.68	8.86E-04	51.63%
222.73	8.34E-04	51.53%
272.80	7.41E-04	51.41%
332.87	5.81E-04	51.29%
392.93	5.21E-04	51.19%
453.00	4.74E-04	51.10%
543.07	3.94E-04	50.98%
663.13	3.43E-04	50.85%
783.20	3.04E-04	50.74%
903.25	2.44E-04	50.64%

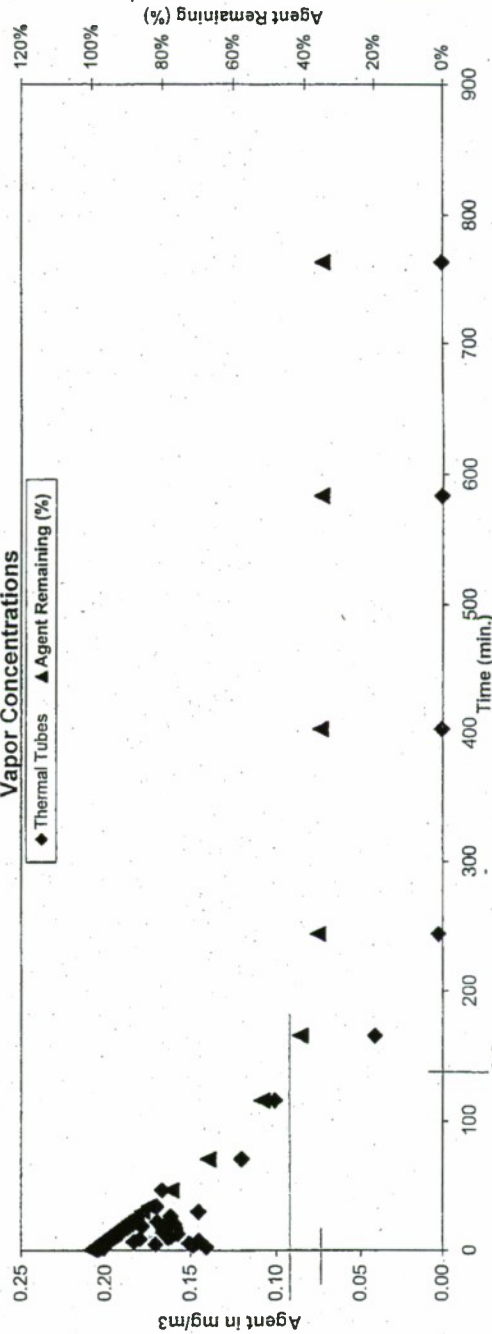
Vapor Concentrations



Data Evaluation Grade: Modeling Grade

Tunnel: 3a		VTS#8/GCMSD		09/28/06 137		Purity 78.2%	
Instruments:		Concrete(CZ04)		.H		1	
Date/Experiment #:		6 µL		7.75 mg		6 µL	
Type of substrate:		Corrected mass on 100% agent purity:		6.06 mg		7.75 mg	
Test agent/purity:		Average substrate temperature:		34.82 °C		35.31 °C	
Number of drops:		Average air temperature above drop:		181.41 SLPM		1.80 m/s	
Nominal drop volume:		Average air flow rate:		11.93 g/m ³		28.8 ug/min	
Mass of agent disseminated:		Test section air flow speed:		65.1 %		n/a %	
Corrected mass on 100% agent purity:		Water vapor concentration:		65.1 %		Yes	
Average substrate temperature:		Crude Evap Rate:		Yes		Yes	
Average air temperature above drop:		Mass % recovery in vapor:		Total agent % mass recovery:		Tube #s consistent:	
Average air flow rate:		Mass % recovery by extraction:		Daily CCV < +/- 15%:			
Test section air flow speed:		Total agent % mass recovery:					
Water vapor concentration:		Tube #s consistent:					
Crude Evap Rate:		Daily CCV < +/- 15%:					
Mass % recovery in vapor:							
Mass % recovery by extraction:							
Total agent % mass recovery:							
Tube #s consistent:							
Daily CCV < +/- 15%:							

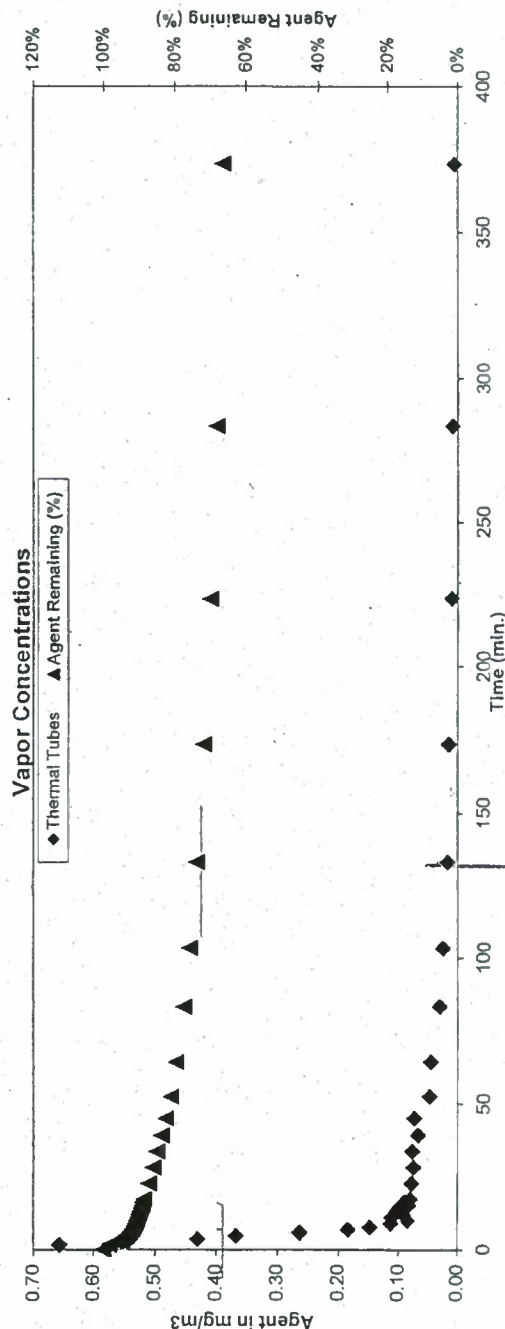
Vapor Concentrations



Data Evaluation Grade: 3c Test Grade (requires further evaluation)

Tunnel:		VTS#1/GCMSD		08/01/06		153	
Instruments:		Concrete(CZ04)		H		Purity	
Date/Experiment #:		1		6 µL		78.2%	
Type of substrate:		Mass of agent disseminated:		7.75 mg			
Test agent/purity:		Corrected mass on 100% agent purity:		6.06 mg			
Number of drops:		Average substrate temperature:		35.53 °C			
Nominal drop volume:		Average air temperature above drop:		35.65 °C			
		Average air flow rate:		181.01 SLPM			
		Test section air flow speed:		1.72 m/s			
		Water vapor concentration:		0.00 g/m³			
		Crude Evap Rate:		33.6 %			
		Mass % recovery in vapor:		5.5 %			
		Mass % recovery by extraction:		39.1 %			
		Total agent % mass recovery:		Yes			
		Tube #s constant:		Yes			
		Delly CCV < +/- 15%:					

Data Evaluation		
SD	%SD	Status
0.2	0.51%	Go
0.1	0.24%	Go
7.0	3.85%	Flag
-	-	Go

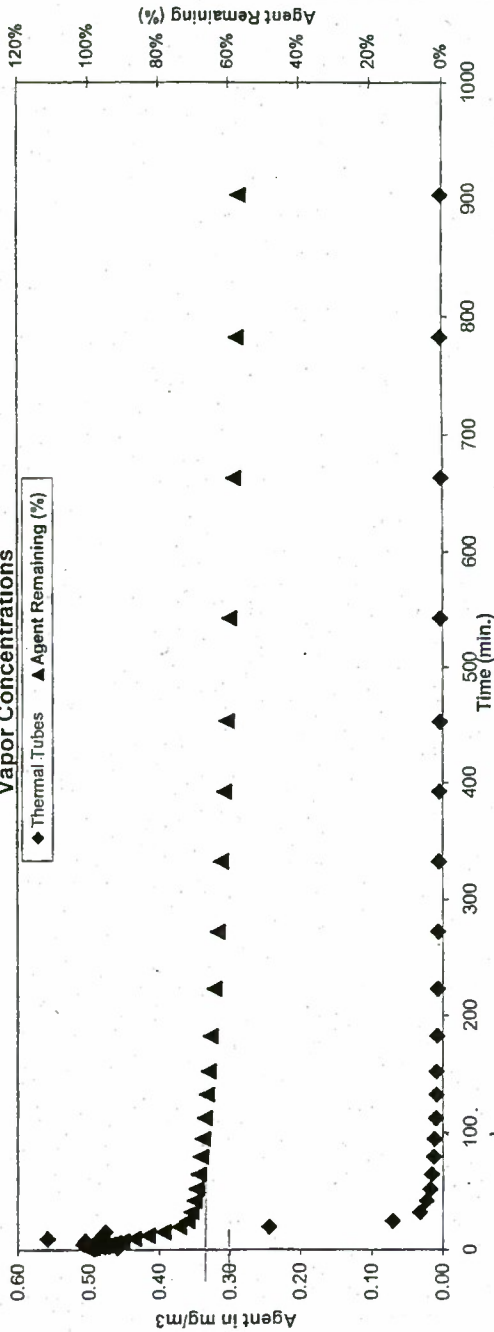


13.5

Data Evaluation Grade: Test Grade (requires further evaluation)

Tunnel: 3c		VTS#1/GCMMSD		152	
Instruments:		07/26/06		Concrete(CZ04)	
Date/Experiment #:		H		Purity	
Type of substrate :		1		78.2%	
Test agent/purity:		6 µL			
Number of drops:		7.75 mg			
Nominal drop volume:		35.71 °C			
Mass of agent disseminated:		35.61 °C			
Corrected mass on 100% agent purity:		181.21 SLPM			
Average substrate temperature:		1.68 m/s			
Average air temperature above drop:		91.5 ug/min			
Average air flow rate:		42.9 %			
Test section air flow speed:		n/a %			
Water vapor concentration:		42.9 %			
Crude Evap Rate:		Yes			
Mass % recovery in vapor:		Yes			
Mass % recovery by extraction:		n/a %			
Total agent % mass recovery:		42.9 %			
Tube #'s consistent:		Yes			
Daily CCV < +/- 15%:		Yes			

Vapor Concentrations



Time (min)	Conc. mg/m³	HD rem. (%)
1.47	4.60E-01	98.99%
2.53	4.72E-01	97.50%
3.60	4.68E-01	96.00%
4.67	5.08E-01	94.45%
5.72	4.91E-01	92.88%
7.28	5.05E-01	90.54%
9.35	5.59E-01	87.26%
11.92	4.80E-01	83.27%
14.98	4.76E-01	78.88%
19.05	2.44E-01	74.50%
24.12	7.16E-02	72.10%
31.68	3.23E-02	70.93%
41.75	2.29E-02	70.10%
51.82	1.75E-02	69.49%
64.38	1.54E-02	68.87%
79.45	1.29E-02	68.23%
94.52	1.16E-02	67.66%
112.08	9.61E-03	67.12%
132.15	8.83E-03	66.57%
152.22	8.75E-03	66.04%
182.28	8.07E-03	65.29%
222.35	7.16E-03	64.37%
272.42	6.59E-03	63.34%
332.48	5.25E-03	62.28%
392.55	4.72E-03	61.38%
452.62	3.99E-03	60.60%
542.68	3.12E-03	59.64%
662.75	2.54E-03	58.63%
782.82	2.15E-03	57.78%
902.88	1.70E-03	57.09%

Data Evaluation Grade: 3c Test Grade (requires further evaluation)

Tunnel: 3c		VTS#1/GCMSD		07/24/06 150		Purity 78.2%	
Instruments:		Date/Experiment #:		Type of substrate :		Test agent/purity:	
		Concrete(CZ04)		H		1	
Number of drops:		Nominal drop volume:		6 µL			
Mass of agent disseminated:		7.75 mg					
Corrected mass on 100% agent purity:		6.06 mg					
Average substrate temperature:		35.45 °C		Go			
Average air temperature above drop:		35.66 °C		Go			
Average air flow rate:		181.15 SLPM		Flag			
Test section air flow speed:		1.67 m/s		Go			
Water vapor concentration:		0.00 g/m^3					
Crude Evap Rate:		3.9 ug/min					
Mass % recovery in vapor:		30.2 %					
Mass % recovery by extraction:		n/a %					
Total agent % mass recovery:		30.2 %					
Tube #s consistent:		Yes					
Daily GCV < +/- 15%:		Yes					

Time (min)	Conc. mg/m³	HD rem. (%)
3.33	1.69E-01	99.16%
9.38	6.22E-02	97.07%
15.43	4.13E-02	96.13%
21.48	3.40E-02	95.45%
27.53	3.34E-02	94.84%
33.57	2.88E-02	94.28%
39.62	3.34E-02	93.71%
48.92	2.58E-02	92.89%
58.47	2.78E-02	92.12%
69.93	2.27E-02	91.26%
81.65	2.63E-02	90.40%
93.37	2.36E-02	89.52%
105.08	1.87E-02	88.78%
121.80	1.67E-02	87.90%
141.02	1.62E-02	86.95%
161.07	1.89E-02	85.90%
181.12	1.83E-02	84.79%
203.67	1.44E-02	83.69%
228.72	1.45E-02	82.61%
256.27	1.25E-02	81.49%
286.32	1.24E-02	80.37%
316.37	9.70E-03	79.38%
356.42	8.92E-03	78.26%
406.47	6.90E-03	77.08%
459.85	6.75E-03	75.99%
523.23	6.47E-03	74.74%
586.62	5.79E-03	73.58%
650.00	5.70E-03	72.49%
743.38	3.49E-03	71.20%
866.77	3.86E-03	69.85%

Vapor Concentrations

◆ Thermal Tubes ▲ Agent Remaining (%)

Time (min.)	Agent in mg/m³ (Thermal Tubes)	Agent Remaining (%) (Thermal Tubes)	Agent Remaining (%) (Agent Remaining %)
0	0.00	0.00	0.00
50	0.01	0.01	0.01
100	0.02	0.02	0.02
150	0.03	0.03	0.03
200	0.04	0.04	0.04
250	0.05	0.05	0.05
300	0.06	0.06	0.06
350	0.07	0.07	0.07
400	0.08	0.08	0.08
450	0.09	0.09	0.09
500	0.10	0.10	0.10
550	0.11	0.11	0.11
600	0.12	0.12	0.12
650	0.13	0.13	0.13
700	0.14	0.14	0.14
750	0.15	0.15	0.15
800	0.16	0.16	0.16
850	0.17	0.17	0.17
900	0.18	0.18	0.18
950	0.17	0.17	0.17
1000	0.16	0.16	0.16

Data Evaluation Grade: 3a Test Grade (requires further evaluation)

Tunnel: 3a		Instruments: VTS#2/GCMSD	
Date/Experiment #: 08/15/06 118		Date/Experiment #: 08/15/06 118	
Type of substrate: Conc. CZ04		Type of substrate: Conc. CZ04	
Test agent/purity: H		Test agent/purity: H	
Number of drops: 1		Number of drops: 1	
Nominal drop volume: 1 µL		Nominal drop volume: 1 µL	
Mass of agent disseminated: 1.29 mg		Mass of agent disseminated: 1.29 mg	
Corrected mass on 100% agent purity: 1.01 mg		Corrected mass on 100% agent purity: 1.01 mg	
Average substrate temperature: 49.93 °C		Average substrate temperature: 49.93 °C	
Average air temperature above drop: 50.13 °C		Average air temperature above drop: 50.13 °C	
Average air flow rate: 16.78 SLPIM		Average air flow rate: 16.78 SLPIM	
Test section air flow speed: 0.43 m/s		Test section air flow speed: 0.43 m/s	
Water vapor concentration: 14.72 g/m³		Water vapor concentration: 14.72 g/m³	
Crude Evap Rate: 7.0 ug/min		Crude Evap Rate: 7.0 ug/min	
Mass % recovery in vapor: 29.9 %		Mass % recovery in vapor: 29.9 %	
Mass % recovery by extraction: n/a %		Mass % recovery by extraction: n/a %	
Total agent % mass recovery: 29.9 %		Total agent % mass recovery: 29.9 %	
Tube #s consistent: Yes		Tube #s consistent: Yes	
Daily CCV < +/- 15%: Yes		Daily CCV < +/- 15%: Yes	

Data Evaluation	
SD	Status
0.4	Go
0.2	Go
5.5	Flag
-	Go

Time (min)	Conc. mg/m³	HD rem. (%)
1.89	7.21E-01	98.87%
4.27	5.16E-01	96.42%
6.55	4.79E-01	94.45%
9.03	4.98E-01	92.52%
11.42	4.46E-01	90.65%
13.80	4.27E-01	88.92%
16.18	5.02E-01	87.08%
18.57	4.18E-01	85.25%
20.95	3.92E-01	83.65%
23.32	3.66E-01	82.16%
25.70	3.65E-01	80.71%
28.08	3.57E-01	79.28%
30.47	3.16E-01	77.95%
32.85	2.99E-01	76.73%
44.15	1.31E-01	72.69%
56.70	5.50E-03	71.27%
61.75	4.08E-03	71.23%
67.80	3.92E-03	71.19%
73.85	3.00E-03	71.15%
79.90	3.44E-03	71.12%
107.45	2.33E-03	70.99%
155.83	1.62E-03	70.83%
225.87	1.20E-03	70.66%
295.92	8.39E-04	70.54%
365.97	8.37E-04	70.45%
436.02	8.07E-04	70.35%
506.07	6.84E-04	70.26%
576.12	5.72E-04	70.19%
646.17	5.20E-04	70.13%
716.22	4.08E-04	70.07%

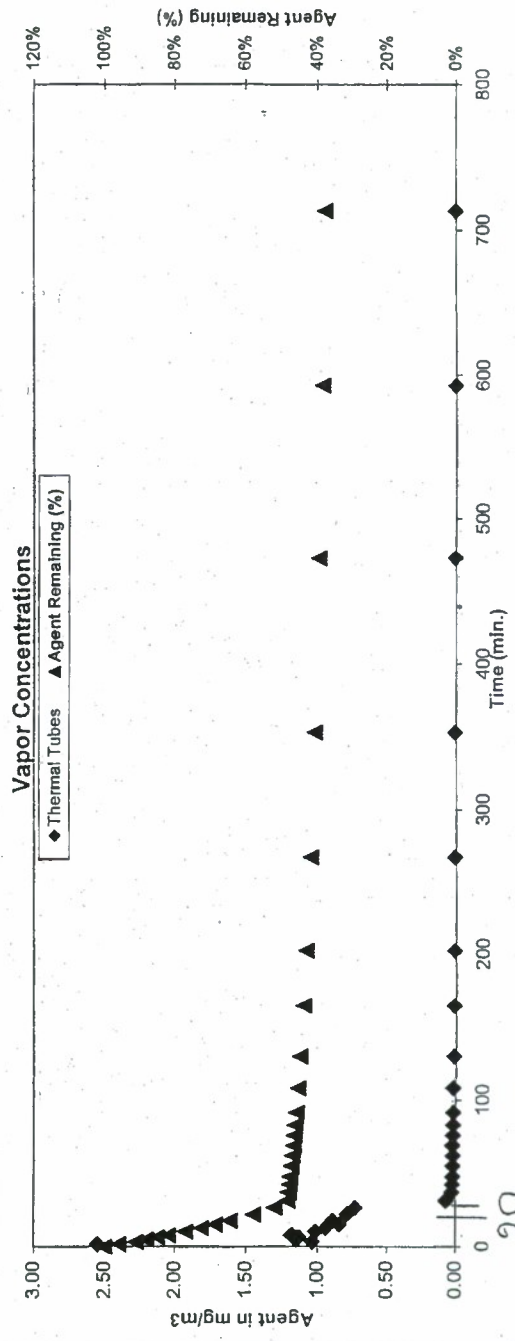
Vapor Concentrations

◆ Thermal Tubes ▲ Agent Remaining (%)

Data Evaluation Grade: Modeling Grade

Tunnel:	3e
Instruments:	VTS#2/GCMSD
Date/Experiment #:	08/31/06 127
Type of substrate :	Concrete(CZ04)
Test agent/purity:	H 78.2%
Number of drops:	1
Nominal drop volume:	1 µL
Mass of agent disseminated:	1.29 mg
Corrected mass on 100% agent purity:	1.01 mg
Average substrate temperature:	49.89 °C
Average air temperature above drop:	49.76 °C
Average air flow rate:	18.04 SLPM
Test section air flow speed:	0.21 m/s
Water vapor concentration:	14.57 g/m ³
Crude Evap Rate:	16.9 ug/min
Mass % recovery in vapor:	62.1 %
Mass % recovery by extraction:	n/a %
Total agent % mass recovery:	62.1 %
Tube #'s consistent:	Yes
Daily CCV < +/- 15%:	Yes

Data Evaluation		
SD	%SD	Status
0.4	0.78%	Go
0.2	0.43%	Go
0.2	1.20%	Go



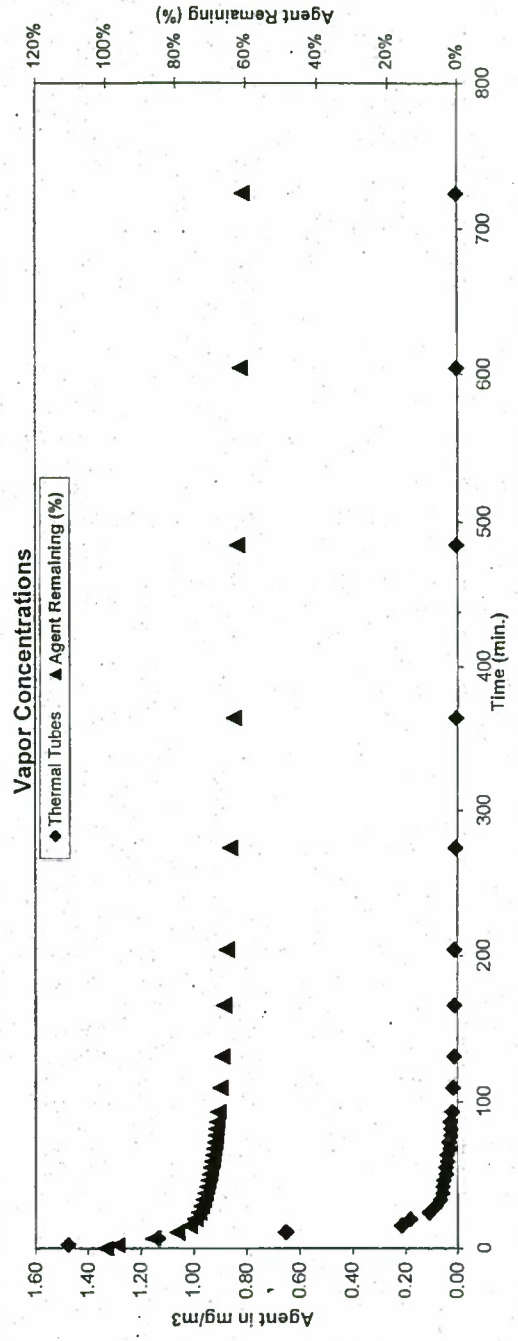
Time (min)	Conc. mg/m ³	HD rem. (%)
1.74	2.55E+00	96.05%
3.24	1.04E+00	91.22%
4.79	1.15E+00	88.19%
6.34	1.13E+00	85.02%
7.89	1.18E+00	81.82%
10.32	1.01E+00	77.06%
12.87	9.43E-01	72.60%
15.33	8.43E-01	68.67%
18.03	8.92E-01	64.48%
22.42	7.88E-01	57.90%
26.80	7.30E-01	51.96%
31.68	6.91E-02	48.47%
37.07	2.76E-02	48.01%
42.45	2.44E-02	47.76%
47.83	2.07E-02	47.54%
54.88	1.92E-02	47.29%
61.93	1.90E-02	47.05%
68.98	2.21E-02	46.79%
76.03	1.78E-02	46.54%
83.08	1.70E-02	46.32%
91.63	1.71E-02	46.06%
108.33	1.71E-02	45.55%
130.05	1.43E-02	44.94%
165.10	1.34E-02	44.07%
202.65	1.15E-02	43.24%
267.70	8.63E-03	42.07%
352.75	6.68E-03	40.90%
472.80	5.04E-03	39.65%
592.85	4.19E-03	38.66%
712.90	2.75E-03	37.91%

Data Evaluation Grade: Modeling Grade

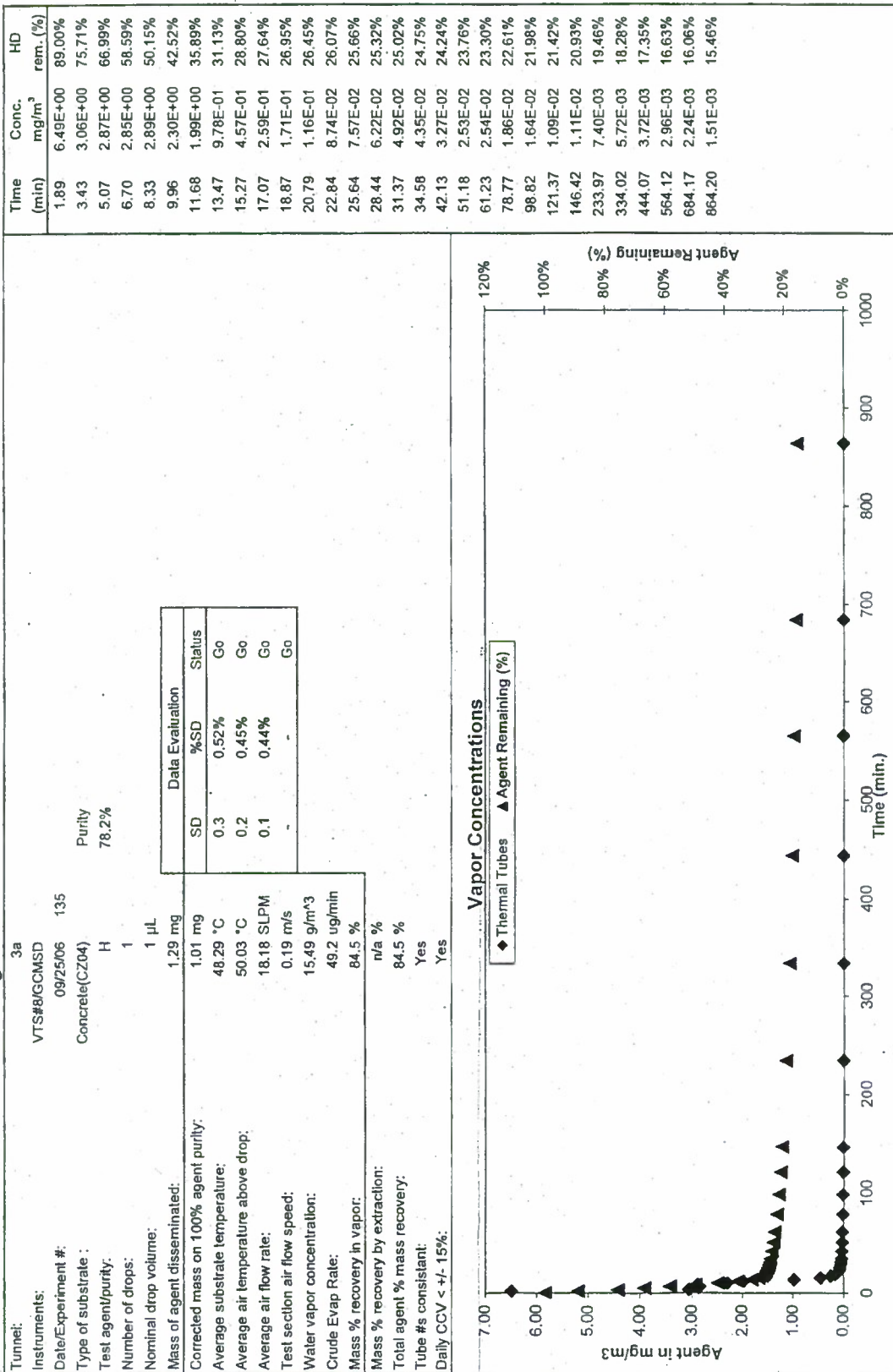
Tunnel: 3a		VTS#2/GCM/SD	
Instruments:	08/21/06	121	
Date/Experiment #:	Conc. CZ04		Purity
Type of substrate:	H		78.2%
Test agent/purity:	1		
Number of drops:	1 µL		
Nominal drop volume:	1.29 mg		
Mass of agent disseminated:	1.01 mg		
Corrected mass on 100% agent purity:	49.98 °C		
Average substrate temperature:	49.51 °C		
Average air temperature above drop:	18.04 SLPM		
Average air flow rate:	0.21 m/s		
Test section air flow speed:	14.62 g/m³		
Water vapor concentration:	19.1 ug/min		
Crude Evap Rate:	39.0 %		
Mass % recovery in vapor:	n/a %		
Mass % recovery by extraction:	39.0 %		
Total agent % mass recovery:	Yes		
Tube #s constant:	Yes		
Daily CCV < +/- 15%:			

Data Evaluation	
SD	%SD Status
0.4	0.82% Go
0.2	0.38% Go
0.1	0.73% Go
-	- Go

Time (min)	Conc. mg/m³	HD rem. (%)
2.48	1.48E+00	96.73%
6.87	1.14E+00	86.50%
11.23	6.52E-01	79.53%
15.62	2.16E-01	76.13%
20.00	1.82E-01	74.57%
24.38	1.09E-01	73.43%
28.77	8.33E-02	72.68%
33.15	6.52E-02	72.10%
37.53	5.69E-02	71.62%
41.92	5.57E-02	71.18%
46.30	5.23E-02	70.76%
50.67	4.28E-02	70.39%
55.05	4.29E-02	70.05%
59.43	3.71E-02	69.74%
63.82	3.95E-02	69.44%
68.20	2.85E-02	69.17%
72.58	3.22E-02	68.94%
76.97	2.54E-02	68.71%
81.35	2.48E-02	68.51%
86.23	2.75E-02	68.29%
93.12	1.95E-02	68.00%
109.83	1.62E-02	67.46%
131.55	1.23E-02	66.91%
166.58	1.04E-02	66.20%
204.13	1.04E-02	65.50%
274.18	6.96E-03	64.42%
364.23	4.97E-03	63.46%
484.28	4.25E-03	62.47%
604.33	3.23E-03	61.67%
724.38	2.80E-03	61.02%



Data Evaluation Grade: Modeling Grade



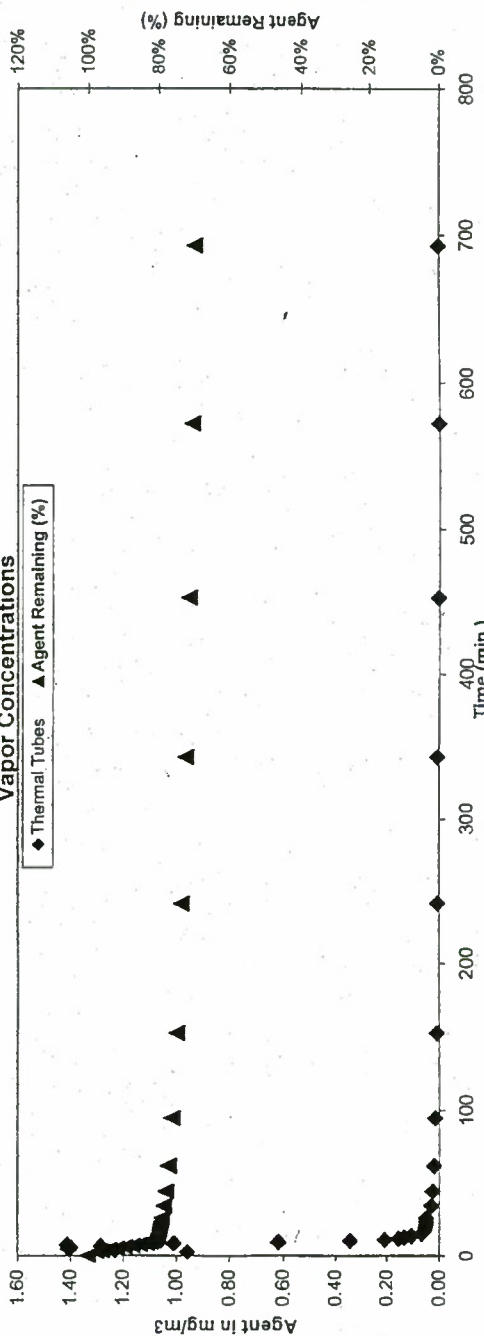
Data Evaluation Grade: Modeling Grade

Tunnel:	3a
Instruments:	VTS#8/GCMSD
Date/Experiment #:	09/27/06 136
Type of substrate :	Concrete(CZ04)
Test agent/purity:	H 78.2%
Number of drops:	1
Nominal drop volume:	1 µL
Mass of agent disseminated:	1.29 mg
Corrected mass on 100% agent purity:	1.01 mg
Average substrate temperature:	49.05 °C
Average air temperature above drop:	50.16 °C
Average air flow rate:	18.07 SLPM
Test section air flow speed:	0.19 m/s
Water vapor concentration:	15.01 g/m ³
Crude Evap Rate:	23.5 ug/min
Mass % recovery in vapor:	30.1 %
Mass % recovery by extraction:	n/a %
Total agent % mass recovery:	30.1 %
Tube #'s consistent:	Yes
Daily CCV < +/- 15%:	Yes

Data Evaluation		
SD	%SD	Status
0.5	1.03%	Go
0.2	0.43%	Go
0.0	0.19%	Go

Time (min)	Conc. mg/m ³	HD rem. (%)
2.80	9.59E-01	97.60%
3.60	1.23E+00	96.03%
4.47	1.40E+00	93.98%
5.35	1.41E+00	91.76%
6.23	1.40E+00	89.53%
7.12	1.28E+00	87.41%
8.00	1.41E+00	85.28%
8.88	1.01E+00	83.37%
9.77	6.20E-01	82.08%
10.65	3.44E-01	81.32%
11.31	2.09E-01	80.99%
12.11	1.56E-01	80.73%
12.91	1.34E-01	80.52%
14.08	1.06E-01	80.27%
15.63	6.63E-02	80.03%
17.81	5.68E-02	79.79%
19.61	5.39E-02	79.61%
21.53	5.08E-02	79.43%
23.58	4.96E-02	79.25%
26.13	5.03E-02	79.02%
34.68	3.01E-02	78.40%
44.73	2.50E-02	77.91%
62.28	1.94E-02	77.21%
94.82	1.58E-02	76.19%
152.37	9.05E-03	74.91%
242.42	6.63E-03	73.65%
342.47	6.37E-03	72.48%
452.52	4.39E-03	71.42%
572.57	3.13E-03	70.61%
692.62	3.38E-03	69.91%

Vapor Concentrations



Data Evaluation Grade: Modeling Grade

Tunnel: 3a		Instruments: VTS#2/GCMSD		Date/Experiment #: 09/06/06 128	
Type of substrate : Concrete(CZ04)		Test agent/purity: H		Purity 78.2%	
Number of drops: 1		Nominal drop volume: 1 µL			
Mass of agent disseminated: 1.29 mg		Corrected mass on 100% agent purity: 1.01 mg			
Average substrate temperature: 49.36 °C		Average air temperature above drop: 49.57 °C			
Average air flow rate: 18.05 SLPm		Test section air flow speed: 0.21 m/s			
Water vapor concentration: 14.58 g/m^3		Crude Evap Rate: 48.6 ug/min			
Mass % recovery in vapor: 70.9 %		Mass % recovery by extraction: n/a %			
Total agent % mass recovery: 70.9 %		Tube #s consistent: Yes			
Daily CCV < +/- 15%: Yes					

Data Evaluation		
SD	%SD	Status
0.4	0.85%	Go
0.2	0.40%	Go
0.1	0.81%	Go

Time (min)	Conc. mg/m³	HD rem. (%)
3.19	4.21E+00	88.01%
5.57	2.98E+00	72.70%
7.94	2.60E+00	60.90%
10.32	1.43E+00	52.32%
12.70	6.70E-01	47.84%
15.09	2.97E-01	45.78%
17.47	1.92E-01	44.74%
19.85	1.81E-01	43.95%
22.24	1.32E-01	43.28%
24.62	9.56E-02	42.79%
26.99	8.67E-02	42.41%
29.37	7.90E-02	42.06%
31.75	8.44E-02	41.71%
34.14	6.19E-02	41.40%
40.35	5.90E-02	40.72%
47.07	4.45E-02	40.10%
53.79	3.85E-02	39.61%
66.17	3.57E-02	38.78%
79.22	2.75E-02	38.05%
93.27	2.34E-02	37.41%
120.82	1.81E-02	36.39%
166.70	1.39E-02	35.08%
234.23	9.43E-03	33.67%
304.28	7.23E-03	32.63%
374.33	5.80E-03	31.81%
454.38	4.78E-03	31.06%
554.43	3.12E-03	30.35%
664.48	2.38E-03	29.81%
774.53	1.81E-03	29.40%
884.58	1.38E-03	29.08%

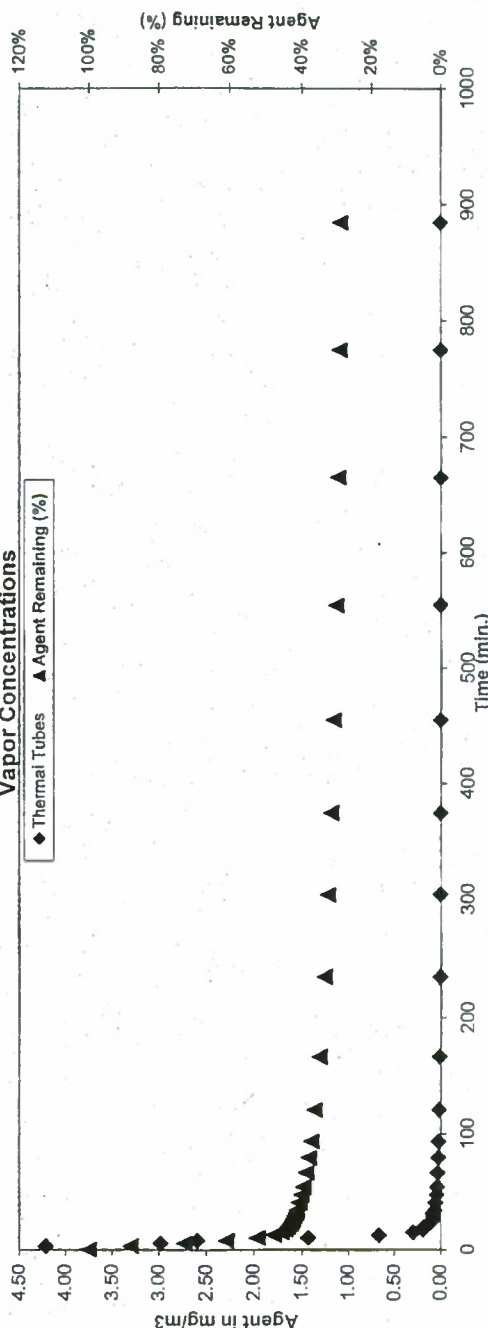
Vapor Concentrations

◆ Thermal Tubes ▲ Agent Remaining (%)

The graph shows the concentration of the agent in mg/m³ over time in minutes. The y-axis ranges from 0.00 to 4.50 mg/m³, and the x-axis ranges from 0 to 1000 minutes. The data points show a sharp peak at 0 minutes, reaching approximately 4.2 mg/m³, and then a rapid decline to about 1.5 mg/m³ by 10 minutes. After 10 minutes, the concentration remains relatively stable, fluctuating between 1.3 and 1.5 mg/m³ for the rest of the 1000-minute period.

Time (min.)	Agent in mg/m³
0	4.21
10	1.50
100	1.45
200	1.40
300	1.35
400	1.30
500	1.25
600	1.20
700	1.15
800	1.10
900	1.05
1000	1.00

Vapor Concentrations

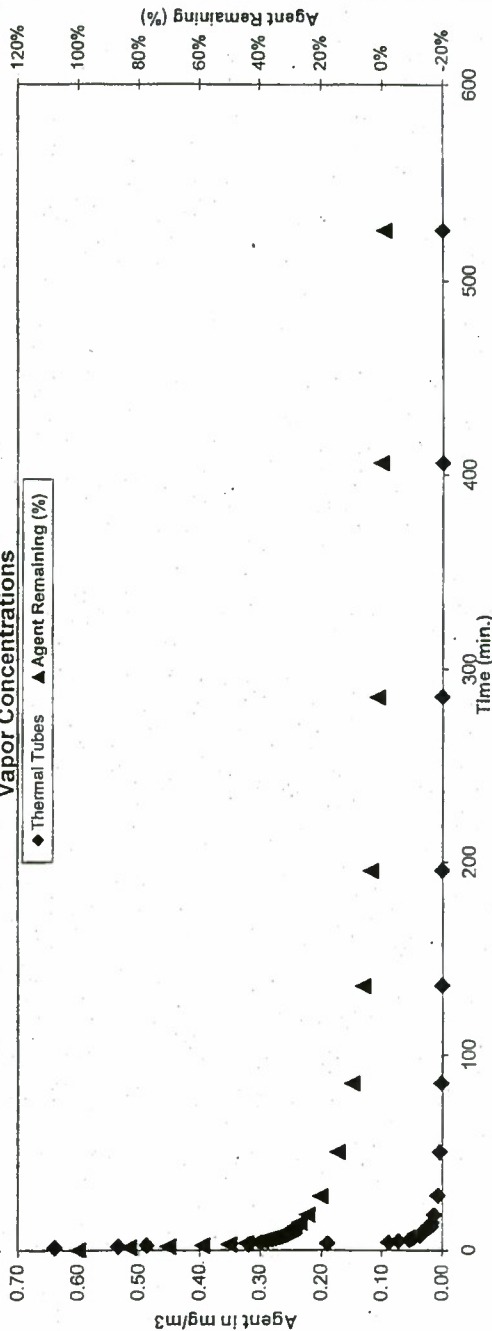


Data Evaluation Grade: Modeling Grade

Tunnel:	3c
Instruments:	VTS#9/GCMSD
Date/Experiment #:	09/25/06 173
Type of substrate :	Concrete(CZ04)
Test agent/purity:	H 78.2%
Number of drops:	1
Nominal drop volume:	1 µL
Mass of agent disseminated:	1.29 mg
Corrected mass on 100% agent purity:	1.01 mg
Average substrate temperature:	50.55 °C
Average air temperature above drop:	50.22 °C
Average air flow rate:	403.39 SLPM
Test section air flow speed:	3.40 m/s
Water vapor concentration:	0.00 g/m ³
Crude Evap Rate:	178.4 ug/min
Mass % recovery in vapor:	100.8 %
Mass % recovery by extraction:	n/a %
Total agent % mass recovery:	100.8 %
Tube #s constant:	Yes
Daily CCV < +/- 15%:	Yes

Data Evaluation		
SD	%SD	Status
0.2	0.32%	Go
0.2	0.47%	Go
1.3	0.32%	Go

Vapor Concentrations



Time (min)	Conc. mg/m³	HD rem. (%)
1.32	6.39E-01	83.20%
1.87	5.34E-01	70.31%
2.42	4.87E-01	59.09%
2.97	3.19E-01	50.23%
3.52	1.90E-01	44.63%
4.05	8.84E-02	41.66%
4.60	7.23E-02	39.90%
5.15	5.46E-02	38.50%
5.70	5.18E-02	37.33%
6.25	4.81E-02	36.24%
6.80	4.63E-02	35.20%
7.35	3.69E-02	34.28%
7.90	3.75E-02	33.47%
8.45	3.26E-02	32.70%
9.00	3.31E-02	31.98%
9.55	3.19E-02	31.26%
10.10	2.82E-02	30.60%
10.65	2.65E-02	30.00%
11.20	2.57E-02	29.43%
12.00	1.93E-02	28.71%
14.05	1.77E-02	27.19%
18.10	1.43E-02	24.61%
28.15	7.65E-03	20.21%
50.70	4.57E-03	14.70%
85.75	2.26E-03	9.92%
135.80	1.32E-03	6.34%
195.85	8.38E-04	3.75%
285.90	3.89E-04	1.54%
405.95	2.15E-04	0.09%
526.00	1.44E-04	-0.77%

Data Evaluation Grade: 3c Test Grade (requires further evaluation)

Tunnel: 3c		VTS#1/GCMUSD	
Instruments:		08/17/06 162	
Date/Experiment #:		Conc. CZ04	
Type of substrate :		Purity 78.2%	
Test agent/purity :		H	
Number of drops:		1	
Nominal drop volume:		1 µL	
Mass of agent disseminated:		1.29 mg	
Corrected mass on 100% agent purity:		1.01 mg	
Average substrate temperature:		50.47 °C	
Average air temperature above drop:		49.73 °C	
Average air flow rate:		404.49 SLPM	
Test section air flow speed:		3.62 m/s	
Water vapor concentration:		0.00 g/m^3	
Crude Evap Rate:		142.2 ug/min	
Mass % recovery in vapor:		88.2 %	
Mass % recovery by extraction:		n/a %	
Total agent % mass recovery:		88.2 %	
Tube #s consistent:		Yes	
Daily CCV < +/- 15%:		Yes	

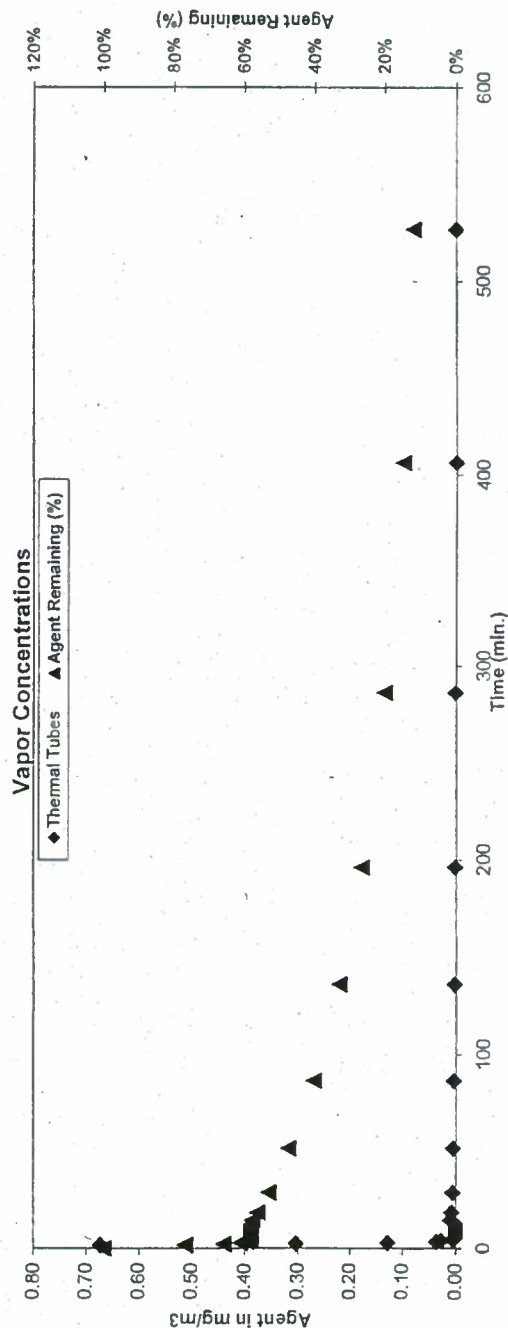
Data Evaluation		
SD	%SD	Status
0.2	0.41%	Go
0.4	0.81%	Go
16.4	4.05%	Flag
-	-	Go

Time (min)	Conc. mg/m³	HD rem. (%)
1.72	6.73E-01	76.84%
2.27	3.04E-01	66.07%
2.82	1.28E-01	61.31%
3.37	3.66E-02	59.50%
3.92	2.79E-02	58.79%
4.47	6.23E-03	58.41%
5.02	2.91E-03	58.31%
5.57	5.47E-04	58.27%
6.12	0.00E+00	58.26%
6.67	0.00E+00	58.26%
7.22	0.00E+00	58.26%
7.77	0.00E+00	58.26%
8.32	0.00E+00	58.26%
8.87	0.00E+00	58.26%
9.42	0.00E+00	58.26%
9.97	0.00E+00	58.26%
10.52	0.00E+00	58.26%
11.07	0.00E+00	58.26%
11.62	0.00E+00	58.26%
12.42	0.00E+00	58.26%
14.47	1.01E-02	57.85%
18.52	8.42E-03	56.34%
28.57	6.57E-03	53.32%
51.12	6.10E-03	47.60%
86.17	4.21E-03	40.36%
136.22	3.06E-03	33.07%
196.27	2.27E-03	26.66%
286.32	1.41E-03	20.04%
406.37	6.71E-04	15.04%
526.42	6.59E-04	11.84%

Vapor Concentrations

◆ Thermal Tubes ▲ Agent Remaining (%)

Time (min.)	Agent in mg/m³ (Thermal Tubes)	Agent Remaining (%)
0	0.00	100
100	0.40	100
200	0.15	20
300	0.05	10
400	0.02	5
500	0.01	2
600	0.00	1



Data Evaluation Grade: **Test Grade (requires further evaluation)**

Tunnel: 3c		VTSS#1/GCMSD		08/14/06		159	
Instruments:		Date/Experiment #:		Conc. CZ04		Purity	
Type of substrate:		H		1		78.2%	
Test agent/purity:		1 µL		1.29 mg		Data Evaluation	
Number of drops:		Corrected mass on 100% agent purity:		1.01 mg		SD	
Nominal drop volume:		Average substrate temperature:		50.59 °C		%SD	
Mass of agent disseminated:		Average air temperature above drop:		50.44 °C		Status	
Corrected mass on 100% agent purity:		Average air flow rate:		404.59 SLPm		0.2	
Average substrate temperature:		Test section air flow speed:		3.60 m/s		0.4	
Average air temperature above drop:		Water vapor concentration:		0.00 g/m³		14.3	
Average air flow rate:		Grude Evap Rate:		85.5 µg/min		-	
Test section air flow speed:		Mass % recovery in vapor:		n/a %		-	
Water vapor concentration:		Mass % recovery by extraction:		81.5 %		-	
Grude Evap Rate:		Total agent % mass recovery:		Yes		-	
Mass % recovery in vapor:		Tube #s consistent:		Yes		-	
Mass % recovery by extraction:		Daily CCV < +/- 15%:		Yes		-	
Total agent % mass recovery:							
Tube #s consistent:							
Daily CCV < +/- 15%:							

Time (min)	Conc. mg/m³	HD rem. (%)
1.90	2.56E-01	90.24%
3.45	2.32E-01	75.09%
5.00	2.15E-01	61.22%
6.55	2.18E-01	47.77%
8.10	1.93E-01	34.99%
9.65	1.26E-01	25.09%
11.20	2.48E-02	20.42%
12.75	4.96E-03	19.50%
14.28	0.00E+00	19.34%
15.83	0.00E+00	19.34%
17.63	0.00E+00	19.34%
19.68	0.00E+00	19.34%
21.73	0.00E+00	19.34%
24.28	0.00E+00	19.34%
28.33	0.00E+00	19.34%
33.40	0.00E+00	19.34%
40.95	5.29E-04	19.26%
50.98	0.00E+00	19.16%
63.53	4.04E-04	19.05%
78.58	8.25E-06	18.93%
93.63	0.00E+00	18.93%
111.18	8.98E-05	18.90%
131.23	0.00E+00	18.86%
161.28	9.44E-05	18.80%
201.33	0.00E+00	18.73%
251.38	5.08E-05	18.68%
311.43	0.00E+00	18.62%
401.48	3.80E-05	18.55%
521.53	0.00E+00	18.46%
641.58	0.00E+00	18.46%

Vapor Concentrations

Legend: ◆ Thermal Tubes ▲ Agent Remaining (%)

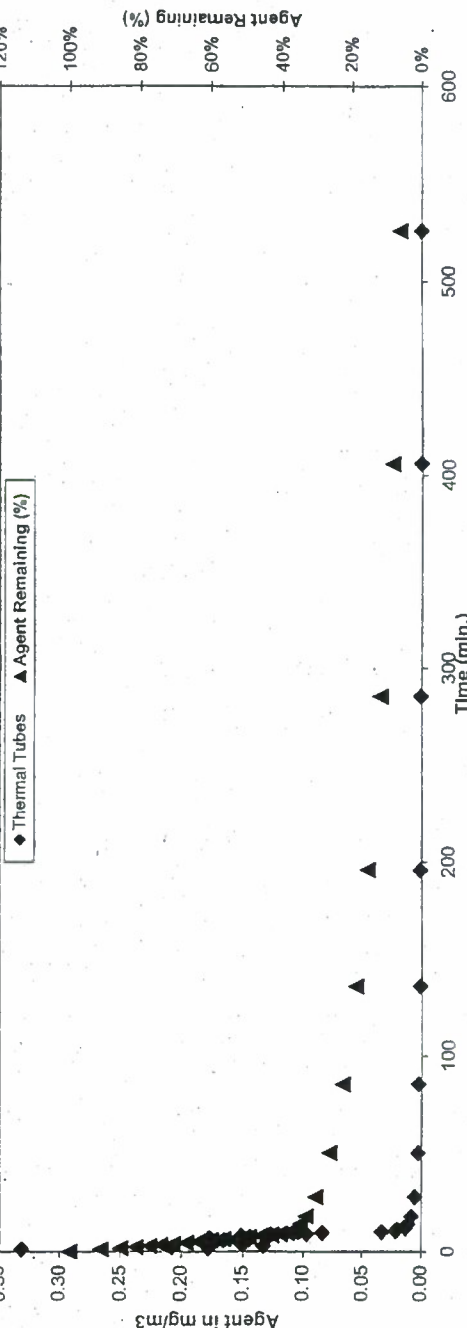
Data Evaluation Grade: **Test Grade (requires further evaluation)**

Tunnel:		3c	
Instruments:	VTSH/GCMMSD		
Date/Experiment #:	08/16/06	161	
Type of substrate :	Conc. CZ04		Purity
Test agent/purity:	H		78.2%
Number of drops:	1		
Nominal drop volume:	1 µL		
Mass of agent disseminated:	1.29 mg		
Corrected mass on 100% agent purity:	1.01 mg		
Average substrate temperature:	49.59 °C		
Average air temperature above drop:	49.80 °C		
Average air flow rate:	404.65 SLPM		
Test section air flow speed:	3.61 m/s		
Water vapor concentration:	0.00 g/m³		
Crude Evap Rate:	64.0 µg/min		
Mass % recovery in vapor:	93.7 %		
Mass % recovery by extraction:	n/a		
Total agent % mass recovery:	93.7 %		
Tube #'s consistent:	Yes		
Daily CCV < +/- 15%:	Yes		

Data Evaluation	
SD	%SD
0.3	0.70%
0.4	0.85%
14.4	3.55%
	Status
	Go
	Go
	Flag
	Go

Time (min)	Conc. mg/m³	HD rem. (%)
1.33	3.31E-01	91.15%
1.88	1.78E-01	85.54%
2.43	2.08E-01	81.29%
2.98	1.33E-01	77.52%
3.53	1.50E-01	74.40%
4.08	1.74E-01	70.82%
4.63	1.53E-01	67.22%
5.18	1.54E-01	63.84%
5.73	1.66E-01	60.32%
6.28	1.45E-01	56.90%
6.83	1.77E-01	53.36%
7.38	1.45E-01	49.82%
7.93	1.52E-01	46.55%
8.48	1.27E-01	43.47%
9.02	9.70E-02	41.07%
9.58	8.38E-02	39.02%
10.13	3.34E-02	37.73%
10.68	2.19E-02	37.12%
11.23	2.06E-02	36.65%
12.03	1.34E-02	36.10%
14.08	1.14E-02	35.09%
18.13	8.34E-03	33.49%
28.18	5.61E-03	30.68%
50.73	3.01E-03	26.78%
85.78	2.51E-03	22.91%
135.83	1.35E-03	19.03%
195.88	1.34E-03	15.79%
285.93	7.99E-04	11.93%
405.98	5.64E-04	8.65%
526.03	3.95E-04	6.34%

Vapor Concentrations



Data Evaluation Grade: 3c Test Grade (requires further evaluation)

Tunnel:		3c	
Instruments:	VTS#1/GCMSD		
Date/Experiment #:	08/15/06	160	
Type of substrate :	Conc. CZ04		Purity
Test agent/purity:	H		78.2%
Number of drops:	1		
Nominal drop volume:	9 µL		
Mass of agent disseminated:	11.62 mg		
Corrected mass on 100% agent purity:	9.09 mg		
Average substrate temperature:	50.10 °C		
Average air temperature above drop:	49.62 °C		
Average air flow rate:	18.49 SLPM		
Test section air flow speed:	0.64 m/s		
Water vapor concentration:	0.00 g/m^3		
Crude Evap Rate:	24.9 ug/min		
Mass % recovery in vapor:	23.6 %		
Mass % recovery by extraction:	0.1 %		
Total agent % mass recovery:	23.7 %		
Tube #'s consistent:	Yes		
Daily COV < +/- 15%:	Yes		

Data Evaluation			
SD	%SD	Status	
0.2	0.35%	Go	
0.1	0.11%	Go	
3.3	17.75%	Flag	
-	-	Go	

Vapor Concentrations

◆ Thermal Tubes ▲ Agent Remaining (%)

Time (min.)	Agent in mg/m³ (Thermal Tubes)	Agent Remaining (%)
0	0.00	0
100	0.00	0
200	0.05	0
300	0.10	0
400	0.15	0
500	0.20	0
600	0.30	0
700	0.40	0
800	0.50	0
900	0.60	0
1000	0.70	0
1100	0.80	0
1200	0.90	0

Time (min)	Conc. mg/m³	HD rem. (%)
1.78	1.87E+00	99.66%
10.33	1.53E+00	96.71%
18.88	1.56E+00	94.02%
27.43	1.17E+00	91.65%
35.98	1.39E+00	89.42%
44.53	1.25E+00	87.13%
53.07	1.30E+00	84.92%
61.62	9.54E-01	82.95%
77.67	7.97E-01	80.10%
93.72	4.14E-01	78.12%
109.77	7.49E-02	77.32%
126.32	3.13E-02	77.14%
143.37	2.61E-02	77.05%
185.92	1.52E-02	76.87%
229.97	8.64E-03	76.76%
274.20	4.91E-03	76.70%
318.40	3.64E-03	76.66%
385.95	2.65E-03	76.62%
456.02	2.43E-03	76.58%
528.57	2.11E-03	76.55%
583.62	2.02E-03	76.52%
641.15	2.48E-03	76.50%
706.22	1.83E-03	76.47%
776.25	1.61E-03	76.44%
806.30	1.87E-03	76.43%
841.35	1.56E-03	76.42%
881.40	1.57E-03	76.41%
921.45	1.47E-03	76.40%
971.50	1.36E-03	76.38%
1031.55	1.12E-03	76.37%

Data Evaluation Grade: Modeling Grade

Tunnel:	3c		
Instruments:	VTS#1/GCMSD		
Date/Experiment #:	09/06/06	170	
Type of substrate:	Concrete(CZ04)		
Test agent/purity:	H		Purity 78.2%
Number of drops:	1		
Nominal drop volume:	9 µL		
Mass of agent disseminated:	11.62 mg		
Corrected mass on 100% agent purity:	9.09 mg		
Average substrate temperature:	50.14 °C		
Average air temperature above drop:	50.11 °C		
Average air flow rate:	18.02 SLP/M		
Test section air flow speed:	0.16 m/s		
Water vapor concentration:	0.00 g/m³		
Crude Evap Rate:	122.7 ug/min		
Mass % recovery in vapor:	80.8 %		
Mass % recovery by extraction:	n/a %		
Total agent % mass recovery:	80.8 %		
Tube #s constant:	Yes		
Daily CCV < +/- 15%:	Yes		

Data Evaluation		
SD	%SD	Status
0.6	1.14%	Go
0.3	0.50%	Go
0.8	4.48%	Go
-	-	Go

Time (min)	Conc. mg/m³	HD rem. (%)
3.30	6.99E+00	97.71%
11.85	7.91E+00	85.09%
20.40	4.44E+00	74.62%
28.95	2.26E+00	68.94%
37.50	1.93E+00	65.38%
46.05	1.57E+00	62.41%
54.60	1.32E+00	59.97%
63.15	1.13E+00	57.90%
79.20	8.18E-01	54.80%
95.25	8.21E-01	52.19%
111.30	7.01E-01	49.77%
127.35	5.99E-01	47.71%
144.38	5.59E-01	45.78%
185.62	4.88E-01	41.50%
229.82	3.62E-01	37.77%
276.38	3.14E-01	34.65%
320.43	2.56E-01	32.16%
367.15	2.10E-01	30.00%
415.53	1.90E-01	28.08%
464.75	1.47E-01	26.43%
537.30	9.54E-02	24.69%
612.35	8.66E-02	23.34%
689.90	6.99E-02	22.13%
769.93	5.90E-02	21.11%
799.98	4.28E-02	20.81%
840.03	4.66E-02	20.45%
880.08	4.42E-02	20.09%
920.13	4.04E-02	19.75%
960.18	3.27E-02	19.46%
1010.23	2.85E-02	19.16%

Vapor Concentrations

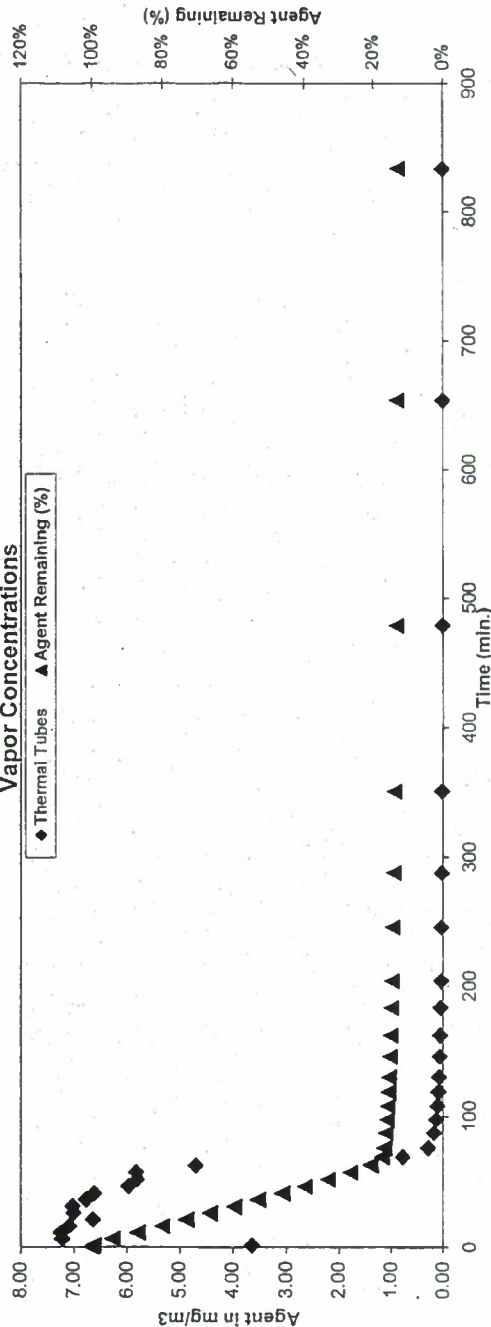
Legend: ◆ Thermal Tubes ▲ Agent Remaining (%)

Data Evaluation Grade: Modeling Grade

Tunnel: 3c		VTS#1/GCMSD	
Instruments:	08/31/06	169	
Date/Experiment #:	Concrete(CZ04)		Purity
Type of substrate :	H		78.2%
Test agent/purity:	1		
Number of drops:	9 µL		
Nominal drop volume:	11.62 mg		
Mass of agent disseminated:	9.09 mg		
Corrected mass on 100% agent purity:	50.23 °C		
Average substrate temperature:	49.91 °C		
Average air temperature above drop:	18.03 SLPM		
Average air flow rate:	0.21 m/s		
Test section air flow speed:	0.00 g/m³		
Water vapor concentration:	120.7 ug/min		
Crude Evap Rate:	86.9 %		
Mass % recovery in vapor:	n/a %		
Mass % recovery by extraction:	86.9 %		
Total agent % mass recovery:	Yes		
Tube #s constant:	Yes		
Daily CCV < +/- 15%:			

SD	%SD	Status
0.2	0.32%	Go
0.1	0.23%	Go
0.6	3.58%	Go
-	-	Go

Vapor Concentrations



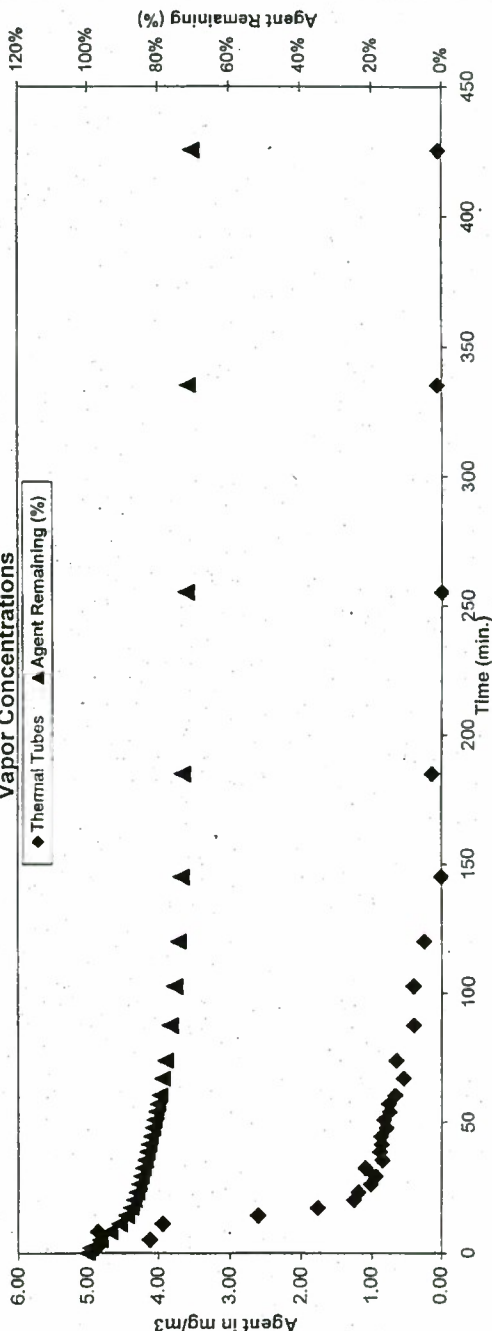
Time (min)	Conc. mg/m³	HD rem. (%)
1.53	3.64E+00	99.45%
6.49	7.21E+00	94.10%
11.46	7.24E+00	86.98%
16.43	7.08E+00	79.92%
21.39	6.64E+00	73.16%
26.36	7.01E+00	66.43%
31.33	7.02E+00	59.52%
36.29	6.77E+00	52.72%
41.26	6.62E+00	46.12%
46.50	5.97E+00	39.57%
52.05	5.81E+00	33.07%
57.60	5.83E+00	26.66%
63.15	4.71E+00	20.86%
69.20	7.69E-01	17.57%
75.75	2.77E-01	16.89%
87.07	1.71E-01	16.39%
97.62	1.27E-01	16.08%
108.17	1.01E-01	15.84%
118.84	8.28E-02	15.64%
129.77	7.52E-02	15.47%
145.82	6.34E-02	15.25%
161.87	5.33E-02	15.07%
182.92	4.62E-02	14.86%
203.97	3.61E-02	14.69%
245.52	2.74E-02	14.42%
287.57	2.17E-02	14.22%
351.12	1.85E-02	13.97%
478.67	1.14E-02	13.59%
653.72	6.62E-03	13.27%
833.77	4.67E-03	13.07%

Data Evaluation Grade: Modeling Grade

Tunnel:		3c
Instruments:	VTS#1/GCMSD	
Date/Experiment #:	08/21/06 163	
Type of substrate :	Conc. CZ04	Purity
Test agent/purity:	H	78.2%
Number of drops:	1	
Nominal drop volume:	9 µL	
Mass of agent disseminated:	11.62 mg	
Corrected mass on 100% agent purity:	9.09 mg	
Average substrate temperature:	50.30 °C	Status
Average air temperature above drop:	50.12 °C	Go
Average air flow rate:	18.03 SLPM	Go
Test section air flow speed:	0.20 m/s	Go
Water vapor concentration:	0.00 g/m ³	Go
Crude Evap Rate:	73.7 ug/min	
Mass % recovery in vapor:	29.5 %	
Mass % recovery by extraction:	n/a %	
Total agent % mass recovery:	29.5 %	
Tube #s consistent:	Yes	
Daily CCV < +/- 15%:	Yes	

Data Evaluation		
SD	%SD	Status
0.3	0.51%	Go
0.2	0.31%	Go
0.6	3.50%	Go

Vapor Concentrations



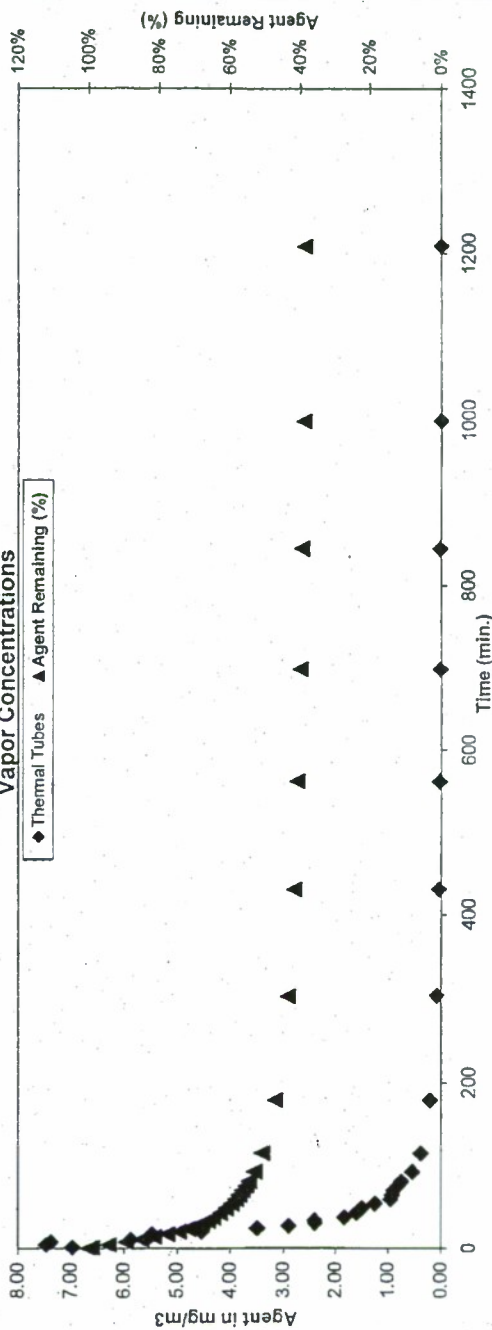
Time (min)	Conc. mg/m ³	HD rem. (%)
1.87	4.87E+00	99.10%
4.92	4.13E+00	96.37%
7.97	4.85E+00	93.66%
11.02	3.94E+00	90.99%
14.07	2.60E+00	89.01%
17.12	1.76E+00	87.69%
20.17	1.25E+00	86.78%
23.22	1.19E+00	86.04%
26.27	1.02E+00	85.37%
29.32	9.48E-01	84.78%
32.37	1.09E+00	84.16%
35.42	8.49E-01	83.57%
38.47	8.82E-01	83.05%
41.52	8.62E-01	82.52%
44.57	8.69E-01	82.00%
47.87	7.92E-01	81.45%
50.92	8.23E-01	80.96%
53.97	7.47E-01	80.49%
57.02	7.57E-01	80.03%
60.32	6.66E-01	79.57%
66.87	5.46E-01	78.78%
73.92	6.48E-01	77.94%
87.47	4.02E-01	76.53%
102.52	4.05E-01	75.33%
120.07	2.52E-01	74.18%
145.12	2.88E-03	73.55%
185.17	1.38E-01	72.99%
255.22	1.57E-03	72.02%
335.27	6.71E-02	71.47%
425.32	4.60E-02	70.46%

Data Evaluation Grade: Modeling Grade

Tunnel:		3c
Instruments:	VTS#9/GCMSD	
Date/Experiment #:	09/27/06 174	
Type of substrate :	Concrete(CZ04)	Purity 78.2%
Test agent/purity:	H	
Number of drops:	1	
Nominal drop volume:	9 µL	
Mass of agent disseminated:	11.62 mg	
Corrected mass on 100% agent purity:	9.09 mg	
Average substrate temperature:	50.82 °C	Status Go
Average air temperature above drop:	50.51 °C	Go
Average air flow rate:	18.01 SLPM	Go
Test section air flow speed:	0.17 m/s	Go
Water vapor concentration:	0.00 g/m³	
Crude Evap Rate:	108.3 ug/min	
Mass % recovery in vapor:	61.2 %	
Mass % recovery by extraction:	n/a %	
Total agent % mass recovery:	61.2 %	
Tube #s consistent:	Yes	
Daily GCV < +/- 15%:	Yes	

Data Evaluation		
SD	%SD	Status
0.2	0.41%	Go
0.2	0.30%	Go
0.6	3.07%	Go
-	-	Go

Vapor Concentrations

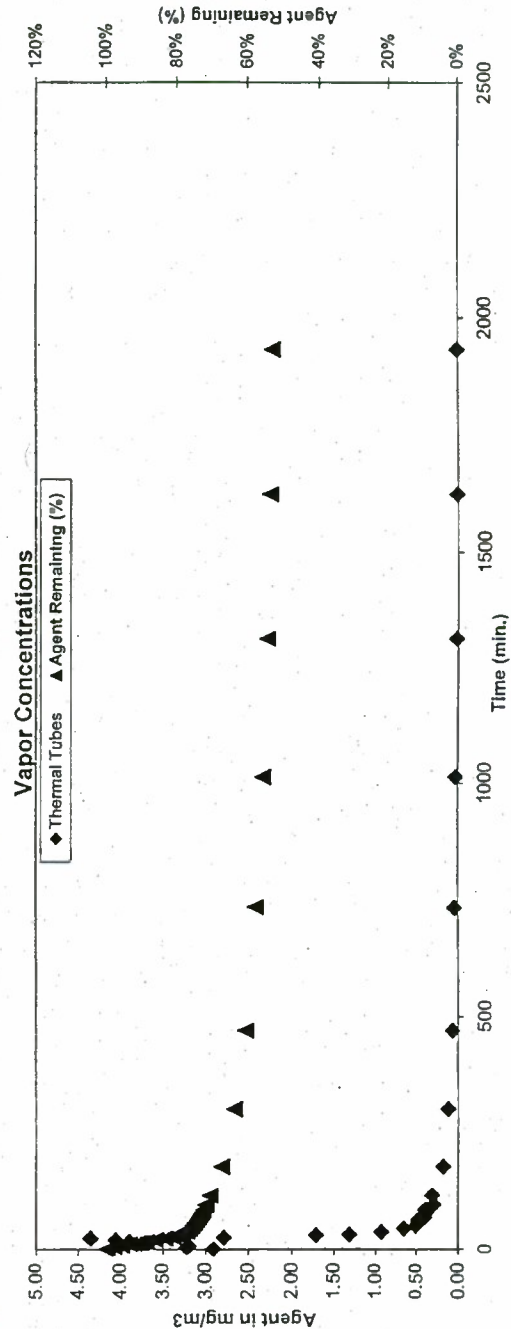


Time (min)	Conc. mg/m³	HD rem. (%)
1.39	6.97E+00	99.04%
4.69	7.46E+00	94.32%
7.99	7.37E+00	89.46%
11.29	5.87E+00	85.13%
14.59	5.51E+00	81.40%
17.89	5.47E+00	77.81%
21.19	4.55E+00	74.53%
24.49	3.50E+00	71.90%
27.78	2.90E+00	69.82%
31.16	2.40E+00	68.04%
34.63	2.40E+00	66.39%
38.38	1.83E+00	64.81%
43.93	1.60E+00	62.92%
49.48	1.50E+00	61.22%
55.03	1.26E+00	59.70%
60.48	9.58E-01	58.51%
65.76	9.27E-01	57.52%
71.06	8.97E-01	56.56%
76.50	8.25E-01	55.63%
82.03	7.51E-01	54.77%
93.58	5.47E-01	53.28%
116.13	3.88E-01	51.19%
179.18	2.15E-01	47.43%
303.23	9.03E-02	43.68%
429.95	4.67E-02	41.96%
561.67	3.30E-02	40.91%
699.22	2.34E-02	40.14%
844.27	1.75E-02	39.56%
999.32	1.04E-02	39.13%
1209.37	6.81E-03	38.77%

Data Evaluation Grade: Modeling Grade

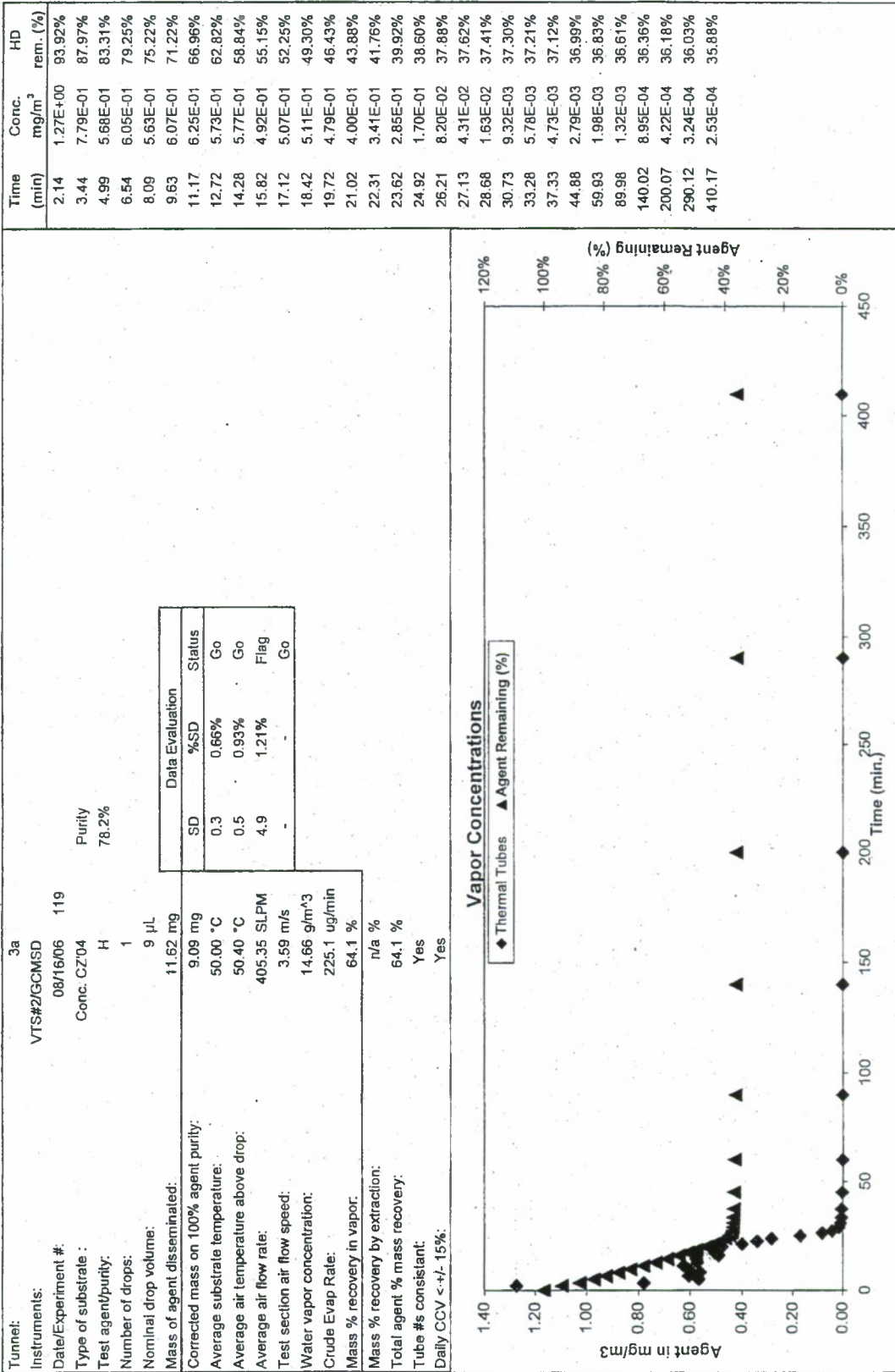
Tunnel: 3c	
Instruments:	VTS#9/GCMSD
Date/Experiment #:	10/02/06 175
Type of substrate:	Concrete(CZ04)
Test agent/purity:	H Purity 78.2%
Number of drops:	1
Nominal drop volume:	g µL
Mass of agent disseminated:	11.62 mg
Corrected mass on 100% agent purity:	9.09 mg
Average substrate temperature:	50.01 °C
Average air temperature above drop:	49.85 °C
Average air flow rate:	18.12 SLPM
Test section air flow speed:	0.17 m/s
Water vapor concentration:	0.00 g/m³
Crude Evap Rate:	68.1 µg/min
Mass % recovery in vapor:	46.8 %
Mass % recovery by extraction:	n/a %
Total agent % mass recovery:	46.8 %
Tube #'s consistent:	Yes
Daily CCV < +/- 15%:	Yes

Data Evaluation		
SD	%SD	Status
0.2	0.42%	Go
0.2	0.32%	Go
0.4	2.05%	Go



Time (min)	Conc. mg/m³	HD rem. (%)
1.27	2.91E+00	99.63%
4.48	3.23E+00	97.66%
7.68	3.20E+00	95.61%
10.90	3.76E+00	93.38%
14.12	3.68E+00	91.00%
17.33	3.90E+00	88.57%
20.53	4.06E+00	86.03%
23.75	4.36E+00	83.33%
26.97	2.79E+00	81.04%
30.35	1.71E+00	79.53%
33.88	1.31E+00	78.46%
39.10	9.29E-01	77.29%
44.90	5.57E-01	76.38%
50.93	5.11E-01	75.67%
56.98	4.85E-01	75.07%
63.28	4.82E-01	74.47%
68.83	4.03E-01	73.98%
74.38	4.12E-01	73.53%
79.93	3.78E-01	73.09%
85.59	3.93E-01	72.65%
96.39	2.92E-01	71.92%
117.32	3.12E-01	70.66%
178.85	1.78E-01	67.65%
302.40	1.21E-01	63.96%
469.12	6.72E-02	60.84%
733.33	4.24E-02	57.95%
1013.37	2.70E-02	56.01%
1313.42	1.64E-02	54.71%
1623.47	1.13E-02	53.86%
1933.52	8.80E-03	53.24%

Data Evaluation Grade: Test Grade (requires further evaluation)



Data Evaluation Grade:	Test Grade (requires further evaluation)
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10

3a	
Instruments: VTS#2/GCM/SD	
Date/Experiment #:	08/17/06 120
Type of substrate :	Conc. CZ04
Test agent/purity:	H 78.2%
Number of drops:	1
Nominal drop volume:	9 µL
Mass of agent disseminated:	11.62 mg
Corrected mass on 100% agent purity:	9.09 mg
Average substrate temperature:	49.70 °C
Average air temperature above drop:	50.09 °C
Average air flow rate:	405.40 SLPM
Test section air flow speed:	3.60 m/s
Water vapor concentration:	14.68 g/m³
Crude Evap Rate:	145.7 ug/min
Mass % recovery in vapor:	63.1 %
Mass % recovery by extraction:	n/a %
Total agent % mass recovery:	63.1 %
Tube #s consistent:	Yes
Daily CCV < +/- 15%:	Yes

Data Evaluation		
SD	%SD	Status
0.3	0.60%	Go
0.5	0.93%	Go
5.5	1.35%	Flag
-	-	Go

Vapor Concentrations

Legend: ◆ Thermal Tubes ▲ Agent Remaining (%)

Time (min.)	Thermal Tubes (mg/m³)	Agent Remaining (%)
0	0.50	100
25	0.52	100
50	0.54	100
75	0.56	100
100	0.58	100
125	0.59	100
150	0.60	100
175	0.60	100
200	0.60	100
225	0.60	100
250	0.60	100
275	0.60	100
300	0.60	100
325	0.60	100
350	0.60	100
375	0.60	100
400	0.60	100
425	0.60	100
450	0.60	100

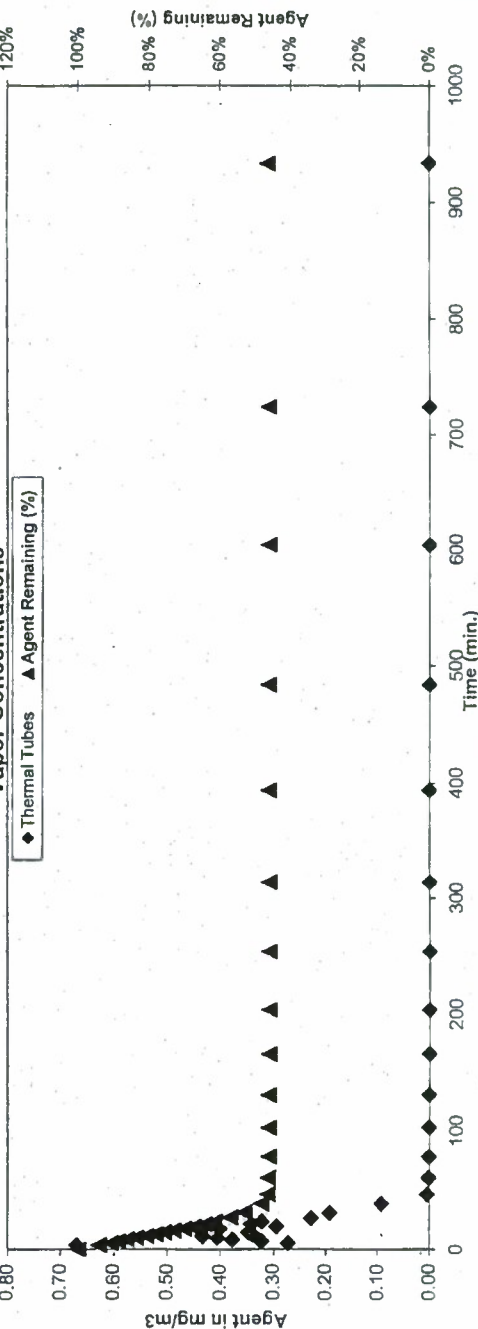
Data Evaluation Grade: **Test Grade (requires further evaluation)**

Tunnel: 3a		VTs#2/GCMSD		08/14/06 117	
Instruments:		Date/Experiment #:		Type of substrate:	Purity
		08/14/06 117		Conc. CZ04	78.2%
Test agent/purity:		H		Number of drops:	1
Nominal drop volume:	9 µL	Mass of agent disseminated:	11.62 mg	Corrected mass on 100% agent purity:	9.09 mg
				Average substrate temperature:	49.78 °C
				Average air temperature above drop:	50.44 °C
				Average air flow rate:	405.28 SLPM
				Test section air flow speed:	3.59 m/s
				Water vapor concentration:	14.59 g/m ³
				Crude Evap Rate:	146.2 µg/min
				Mass % recovery in vapor:	53.7 %
				Mass % recovery by extraction:	n/a %
				Total agent % mass recovery:	53.7 %
				Tube #s consistent:	Yes
				Daily CCV < +/- 15%:	No

Data Evaluation	
SD	%SD
0.7	1.35%
0.5	0.93%
3.9	0.97%
-	-
	Status
	Go
	Go
	Flag
	Go

Time (min)	Conc. mg/m ³	HD rem. (%)
3.87	6.69E-01	94.23%
5.42	2.73E-01	90.97%
6.97	3.23E-01	88.91%
8.52	3.77E-01	86.49%
10.07	4.05E-01	83.79%
11.62	4.34E-01	80.89%
13.17	3.40E-01	78.21%
14.70	3.48E-01	75.86%
16.25	4.38E-01	73.14%
17.80	4.01E-01	70.24%
19.60	2.95E-01	67.45%
21.65	3.42E-01	64.54%
23.70	3.23E-01	61.50%
27.25	2.28E-01	57.13%
31.30	1.94E-01	53.33%
38.85	9.17E-02	48.52%
46.90	4.22E-03	46.80%
60.95	1.67E-03	46.61%
78.50	1.10E-03	46.50%
103.55	4.56E-04	46.42%
131.10	2.91E-04	46.37%
166.13	1.26E-04	46.34%
203.68	0.00E+00	46.33%
253.73	0.00E+00	46.33%
313.78	0.00E+00	46.33%
393.83	0.00E+00	46.33%
483.88	0.00E+00	46.33%
603.93	0.00E+00	46.33%
723.98	0.00E+00	46.33%
934.03	0.00E+00	46.33%

Vapor Concentrations

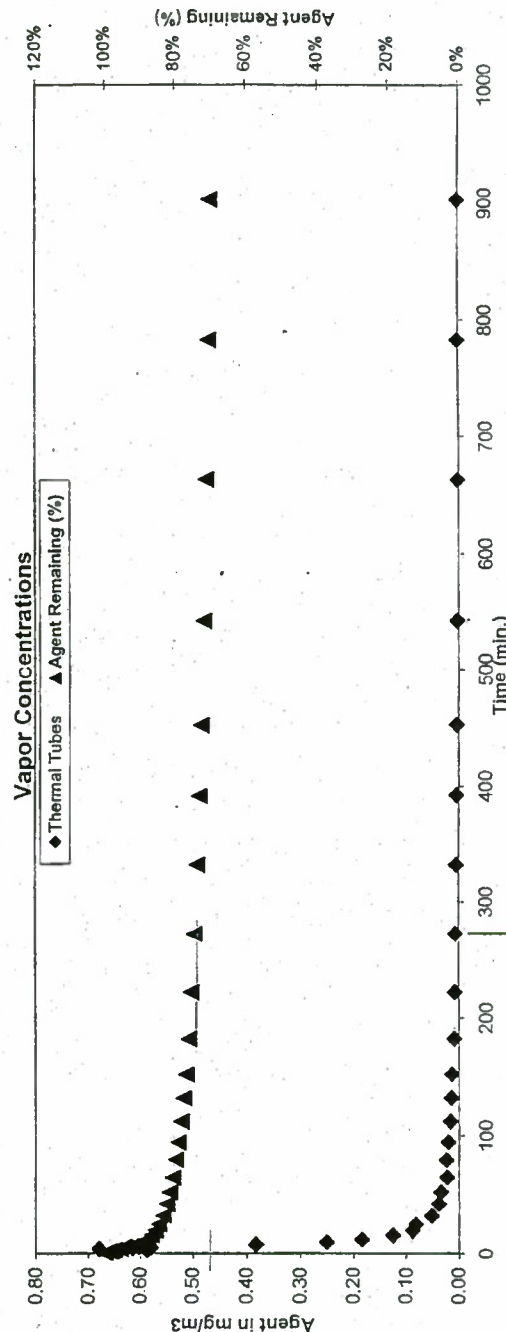


Data Evaluation Grade: Test Grade (requires further evaluation)

Tunnel: 3c		VTs#1/CGMSD		151	
Instruments:		Date/Experiment #:	07/25/06	Concrete	Purity
Type of substrate :		Test agent/purity:	HD	1	97.4%
Number of drops:		Nominal drop volume:	6 µL		
Mass of agent disseminated:		Corrected mass on 100% agent purity:	7.75 mg		
Average substrate temperature:		Average air temperature above drop:	35.76 °C		
Average air flow rate:		Test section air flow speed:	1.68 m/s		
Water vapor concentration:		Crude Evap Rate:	0.00 g/m ³		
Mass % recovery in vapor:		Mass % recovery by extraction:	30.1 %		
Total agent % mass recovery:		Tube #s consistent:	n/a %		
Daily CCV < +/- 15%:			Yes		

Data Evaluation	
SD	Status
0.2	Go
0.2	Go
5.7	Flag
	Go

Time (min)	Conc. mg/m ³	HD rem. (%)
1.55	6.41E-01	98.81%
2.62	5.87E-01	97.23%
3.68	6.79E-01	95.61%
4.75	5.80E-01	94.00%
5.82	6.17E-01	92.47%
7.38	3.82E-01	90.59%
9.45	2.50E-01	89.02%
12.02	1.83E-01	87.68%
15.08	1.25E-01	86.55%
19.15	8.70E-02	85.51%
24.20	8.05E-02	84.50%
31.77	5.09E-02	83.30%
41.83	3.76E-02	82.23%
51.90	3.39E-02	81.37%
64.47	2.29E-02	80.51%
79.55	2.36E-02	79.67%
94.60	2.00E-02	78.88%
112.17	1.61E-02	78.12%
132.23	1.41E-02	77.39%
152.30	1.32E-02	76.73%
182.37	8.95E-03	75.93%
222.43	7.53E-03	75.14%
272.50	6.16E-03	74.32%
332.57	4.92E-03	73.52%
392.63	4.29E-03	72.86%
452.70	3.77E-03	72.27%
542.77	2.83E-03	71.56%
662.83	2.27E-03	70.82%
782.90	1.45E-03	70.29%
902.97	1.48E-03	69.87%



2.80

Data Evaluation Grade: 3a Test Grade (requires further evaluation)

Tunnel: 3a		VTS#2/GCMUSD		07/25/06		109		Purity		97.4%	
Instruments:		Concrete		HD		1		6 µL		7.75 mg	
Date/Experiment #:		Corrected mass on 100% agent purity:		7.54 mg		Status		SD		%SD	
Type of substrate :		Average substrate temperature:		34.78 °C		Go		0.1		0.32%	
Test agent/purity:		Average air temperature above drop:		35.26 °C		Go		0.2		0.64%	
Number of drops:		Average air flow rate:		181.84 SLPM		Flag		2.6		1.43%	
Nominal drop volume:		Test section air flow speed:		1.70 m/s		Go					
Mass of agent disseminated:		Water vapor concentration:		16.41 g/m³							
Corrected mass on 100% agent purity:		Crude Evap Rate:		54.0 µg/min							
Average substrate temperature:		Mass % recovery in vapor:		27.2 %							
Average air temperature above drop:		Mass % recovery by extraction:		n/a %							
Average air flow rate:		Total agent % mass recovery:		27.2 %							
Test section air flow speed:		Tube #s consistent:		Yes							
Water vapor concentration:		Daily CCV < +/- 15%:		Yes							
Crude Evap Rate:											
Mass % recovery in vapor:											
Mass % recovery by extraction:											
Total agent % mass recovery:											
Tube #s consistent:											
Daily CCV < +/- 15%:											

Time (min)	Conc. mg/m³	HD rem. (%)
1.23	9.32E-01	98.62%
2.30	8.42E-01	96.34%
3.37	8.98E-01	94.10%
4.43	8.96E-01	91.79%
5.50	8.95E-01	89.49%
7.07	5.90E-01	86.69%
9.13	3.68E-01	84.30%
11.70	1.58E-01	82.68%
14.77	8.49E-02	81.78%
18.82	5.57E-02	81.10%
23.88	4.18E-02	80.50%
31.45	2.60E-02	79.89%
41.52	1.89E-02	79.34%
51.58	1.38E-02	78.95%
64.15	1.24E-02	78.55%
79.22	9.62E-03	78.15%
94.28	8.92E-03	77.81%
111.85	6.41E-03	77.49%
131.92	5.60E-03	77.20%
151.98	6.27E-03	76.91%
182.05	4.59E-03	76.52%
222.10	3.83E-03	76.11%
272.17	3.52E-03	75.67%
332.23	2.96E-03	75.20%
392.30	2.52E-03	74.80%
452.37	2.36E-03	74.45%
542.43	1.84E-03	73.99%
662.50	1.52E-03	73.51%
782.57	1.35E-03	73.09%
902.63	9.16E-04	72.76%

50

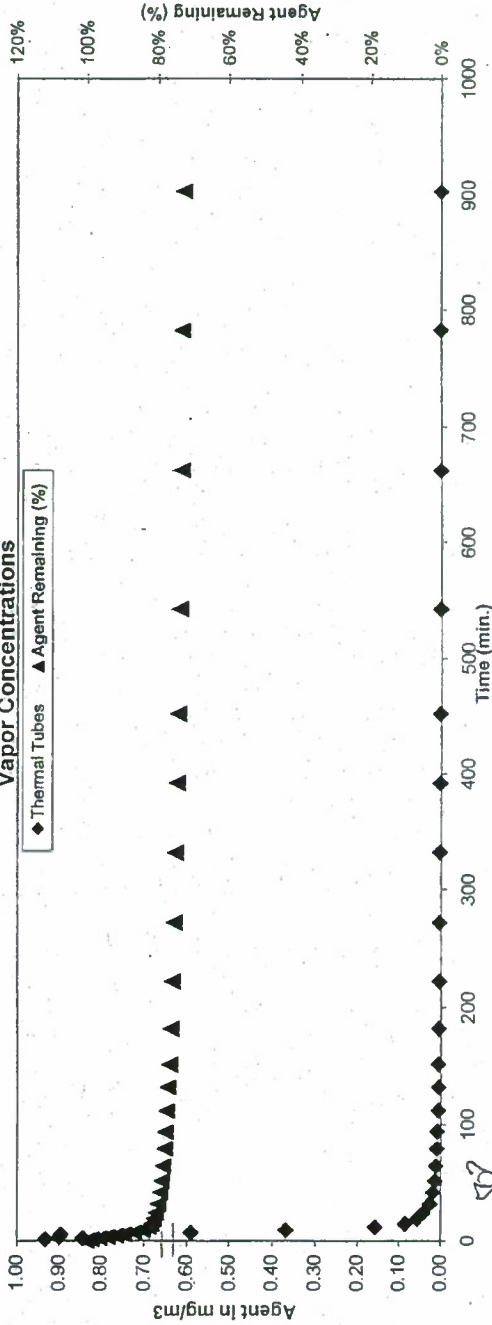
Vapor Concentrations

◆ Thermal Tubes ▲ Agent Remaining (%)

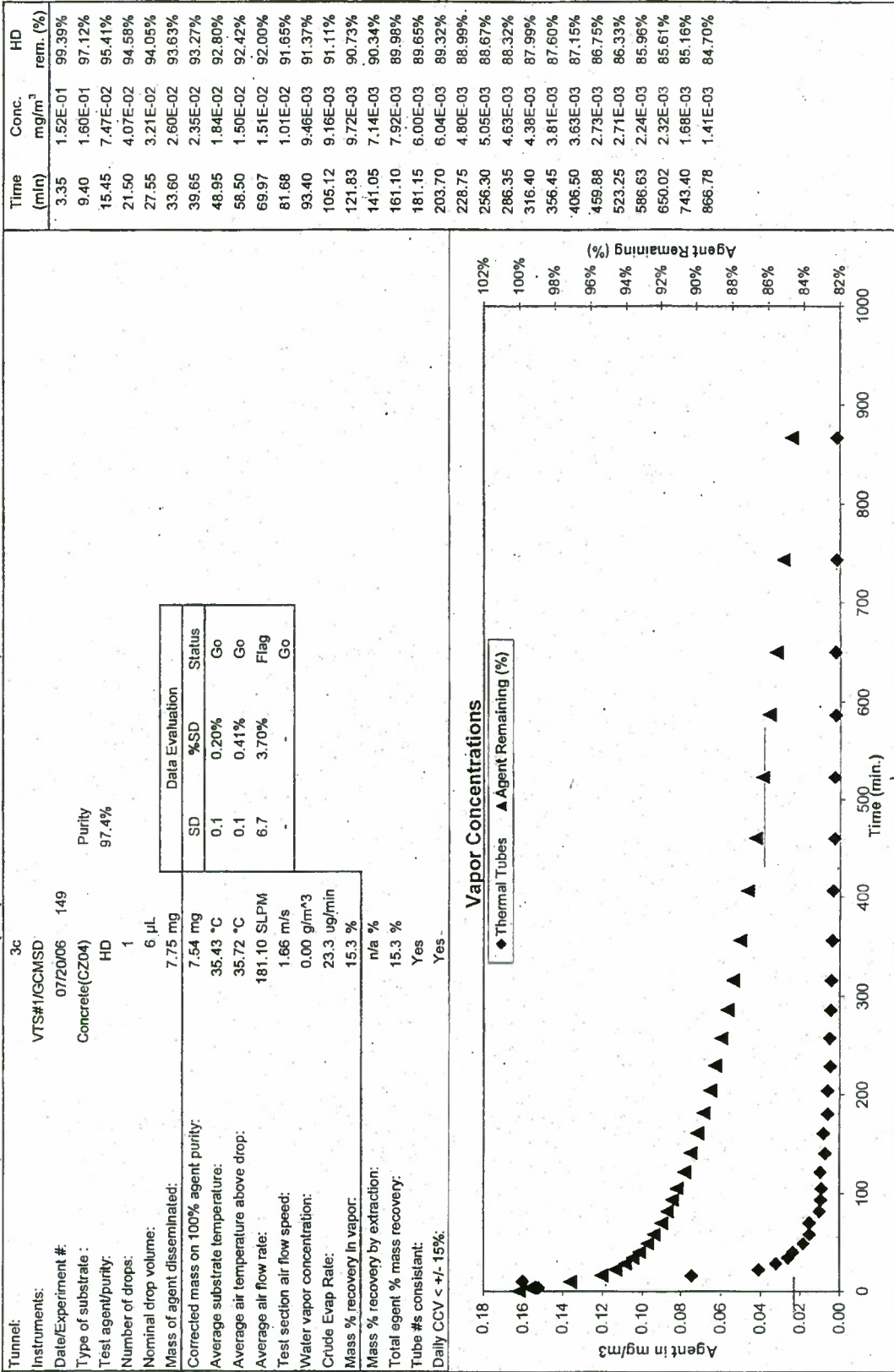
Agent in mg/m3

Time (min.)

Vapor Concentrations



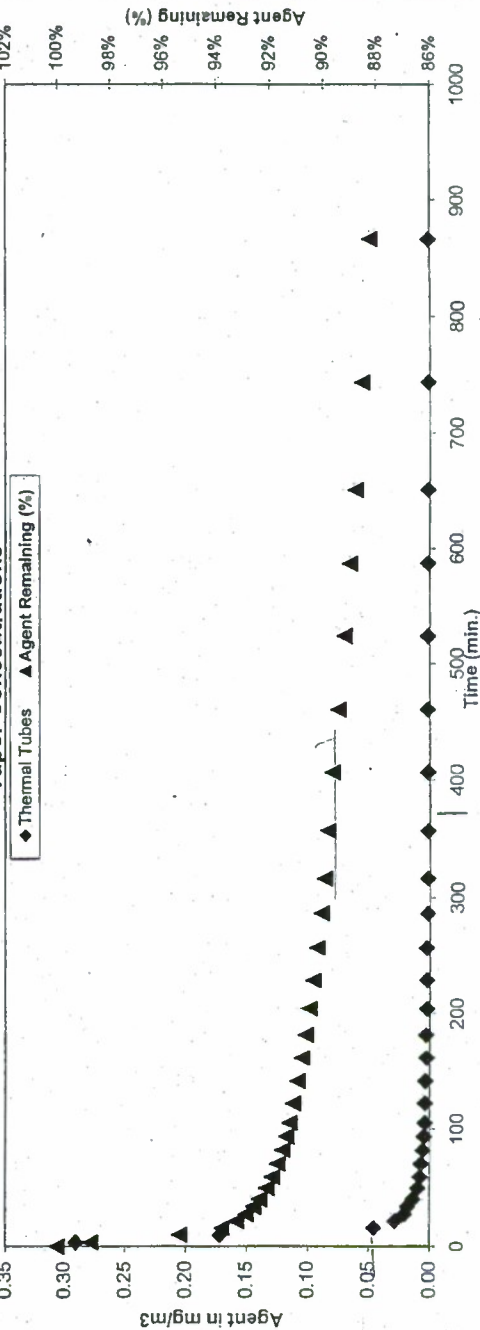
Data Evaluation Grade: **Test Grade (requires further evaluation)**



Data Evaluation Grade: Test Grade (requires further evaluation)

Tunnel: 3a		VTS#2/GCMUSD		07/20/06		107	
Instruments:		Concrete(CZ04)		HD		Purity	
Date/Experiment #:		1		6 µL		97.4%	
Type of substrate:		7.75 mg		35.09 °C		Go	
Test agent/purity:		35.39 °C		181.85 SLPm		Flag	
Number of drops:		1.69 m/s		17.47 g/m³		Go	
Nominal drop volume:		31.2 µg/min		n/a %			
Mass of agent disseminated:		11.8 %		11.8 %		Yes	
Corrected mass on 100% agent purity:		n/a %		Yes			
Average substrate temperature:							
Average air temperature above drop:							
Average air flow rate:							
Test section air flow speed:							
Water vapor concentration:							
Crude Evap Rate:							
Mass % recovery in vapor:							
Mass % recovery by extraction:							
Total agent % mass recovery:							
Tube #s consistent:							
Daily CCV < +/- 15%:							

Vapor Concentrations

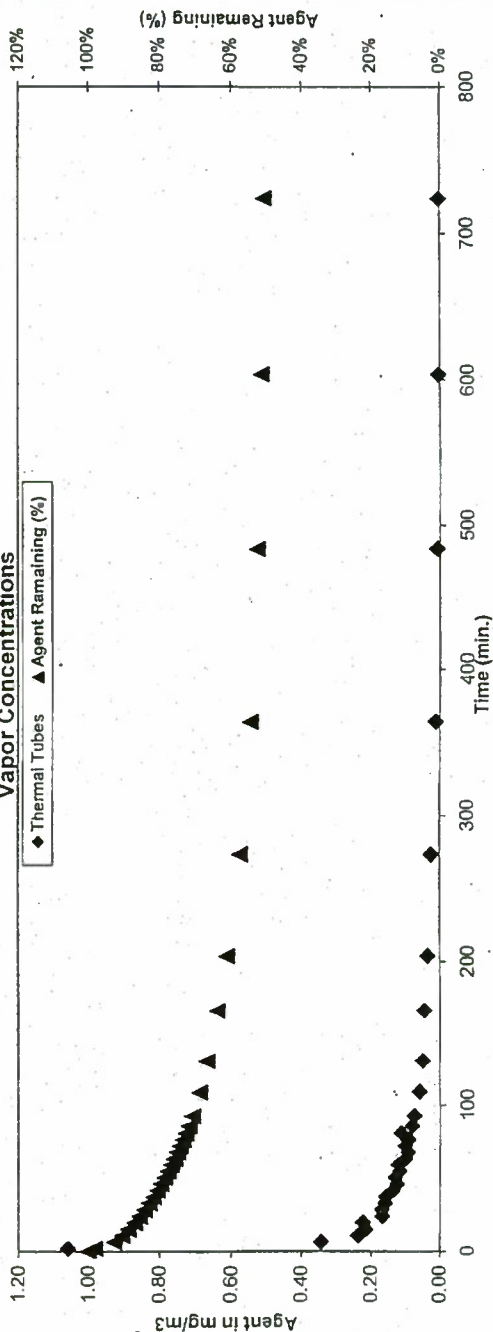


Data Evaluation Grade: Modeling Grade

Tunnel:	3a
Instruments:	VTS#2/GCMSD
Date/Experiment #:	08/22/06 122
Type of substrate:	Concrete(CZ04)
Test agent/purity:	H Purity 78.2%
Number of drops:	1
Nominal drop volume:	1 µL
Mass of agent disseminated:	1.29 mg
Corrected mass on 100% agent purity:	1.01 mg
Average substrate temperature:	51.04 °C
Average air temperature above drop:	49.72 °C
Average air flow rate:	18.04 SLPm
Test section air flow speed:	0.21 m/s
Water vapor concentration:	14.64 g/m ³
Crude Evap Rate:	2.6 ug/min
Mass % recovery in vapor:	49.3 %
Mass % recovery by extraction:	n/a %
Total agent % mass recovery:	49.3 %
Tube #s consistent:	Yes
Daily CCV < +/- 15%:	Yes

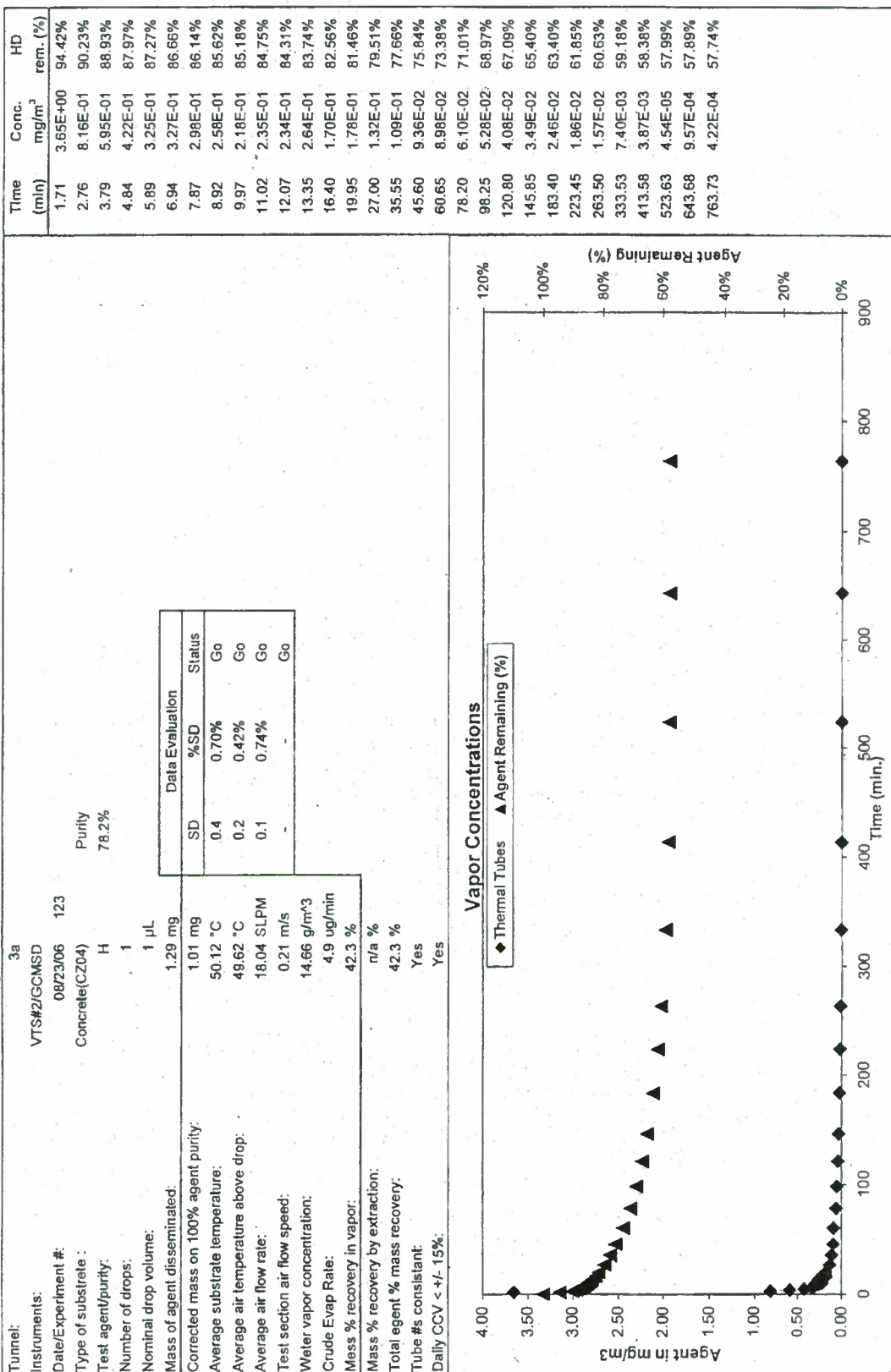
Data Evaluation		
SD	%SD	Status
0.4	0.83%	Go
0.2	0.41%	Go
0.1	0.73%	Go
-	-	Go

Vapor Concentrations



rippled

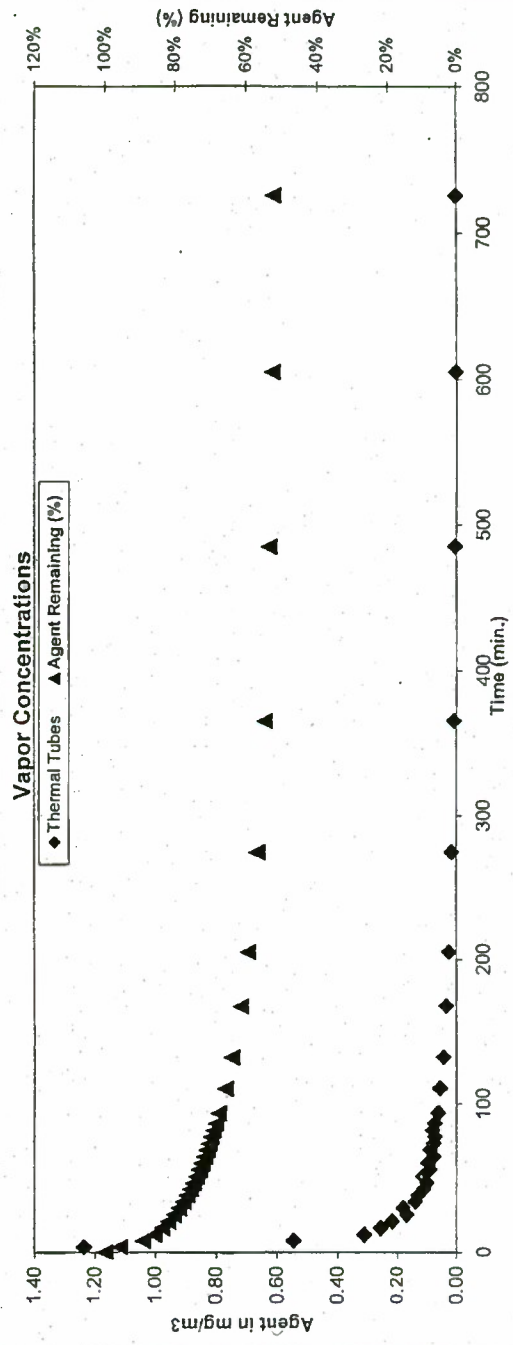
Data Evaluation Grade: Modeling Grade



Data Evaluation Grade: Modeling Grade

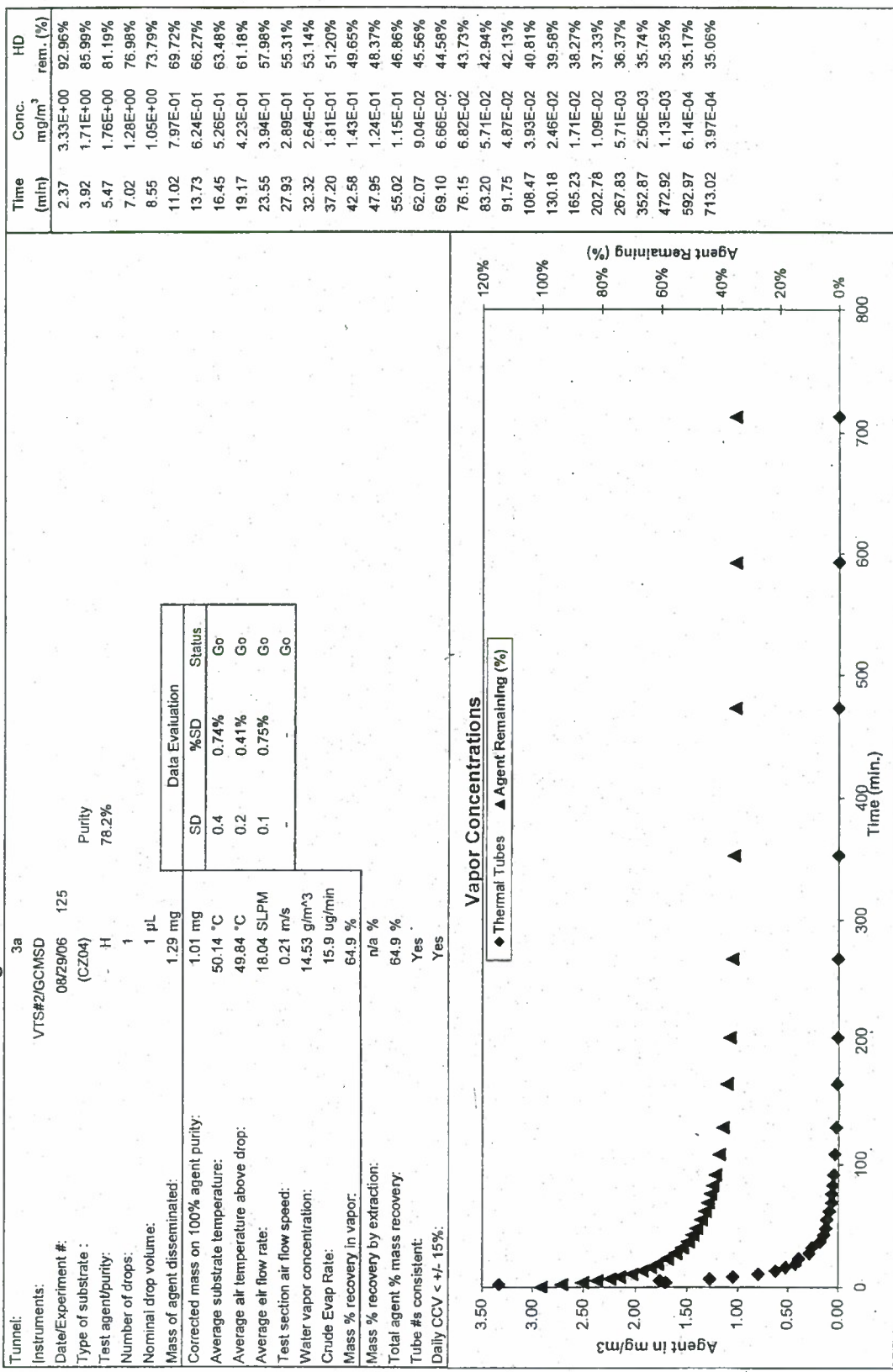
Tunnel:	3a
Instruments:	VTS#2/GCMSD
Date/Experiment #:	08/25/06 124
Type of substrate:	(CZ04)
Test agent/purity:	H 78.2%
Number of drops:	1
Nominal drop volume:	1 µL
Mass of agent disseminated:	1.29 mg
Corrected mass on 100% agent purity:	1.01 mg
Average substrate temperature:	50.29 °C
Average air temperature above drop:	49.60 °C
Average air flow rate:	18.04 SLPm
Test section air flow speed:	0.21 m/s
Water vapor concentration:	14.64 g/m ³
Crude Evap Rate:	2.5 µg/min
Mass % recovery in vapor:	47.7 %
Mass % recovery by extraction:	n/a %
Total agent % mass recovery:	47.7 %
Tube #s consistent:	Yes
Daily CCV < +/- 15%:	Yes

Data Evaluation		
SD	%SD	Status
0.3	0.60%	Go
0.1	0.23%	Go
0.1	0.74%	Go
-	-	Go



Time (min)	Conc. mg/m ³	HD rem. (%)
3.78	1.24E+00	95.82%
7.92	5.46E-01	89.25%
12.30	3.12E-01	85.89%
16.67	2.57E-01	83.66%
21.05	2.19E-01	81.80%
25.43	1.69E-01	80.28%
29.82	1.80E-01	78.91%
34.20	1.39E-01	77.66%
38.58	1.29E-01	76.61%
42.97	1.11E-01	75.67%
47.35	1.00E-01	74.84%
51.73	1.14E-01	74.00%
56.12	9.09E-02	73.20%
60.48	9.54E-02	72.47%
64.87	7.79E-02	71.80%
69.27	8.89E-02	71.14%
73.63	7.75E-02	70.49%
78.02	7.38E-02	69.90%
82.40	8.04E-02	69.30%
87.28	7.30E-02	68.63%
94.17	6.16E-02	67.80%
110.88	5.55E-02	66.05%
132.60	4.36E-02	64.13%
167.65	3.52E-02	61.66%
205.20	2.54E-02	59.63%
275.25	1.69E-02	56.98%
365.30	8.71E-03	54.92%
485.33	4.64E-03	53.49%
605.38	2.39E-03	52.74%
725.43	1.33E-03	52.35%

Data Evaluation Grade: Modeling Grade

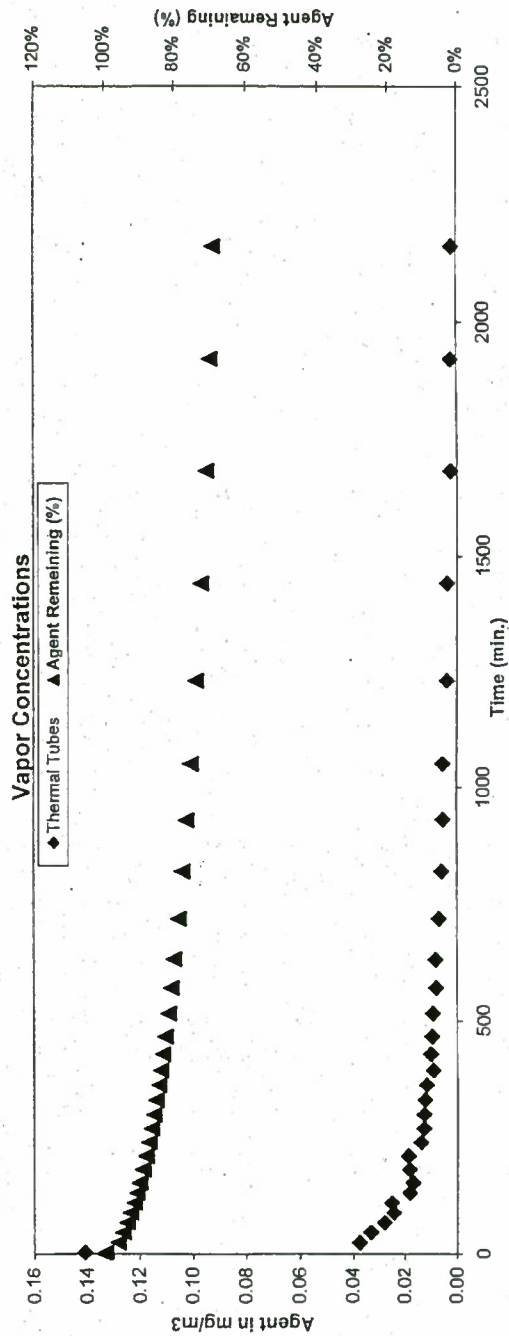


Data Evaluation Grade: Modeling Grade

Tunnel:		3d	
Instruments:	VTS#7/GCMSD		
Date/Experiment #:	08/29/06	58	
Type of substrate:	Concrete(CZ04)		Purity
Test agent/purity:	H		78.2%
Number of drops:	1		
Nominal drop volume:	1 µL		
Mass of agent disseminated:	1.29 mg		
Corrected mass on 100% agent purity:	1.01 mg		
Average substrate temperature:	15.22 °C		
Average air temperature above drop:	15.38 °C		
Average air flow rate:	18.19 SLPM		
Test section air flow speed:	0.25 m/s		
Water vapor concentration:	0.00 g/m³		
Crude Evap Rate:	0.4 ug/min		
Mass % recovery in vapor:	30.9 %		
Mass % recovery by extraction:	n/a %		
Total agent % mass recovery:	30.9 %		
Tube #s consistent:	Yes		
Daily CCV < +/- 15%:	Yes		

Data Evaluation		
SD	%SD	Status
0.4	2.68%	Go
0.2	1.58%	Go
0.9	4.82%	Go
-	-	Go

Time (min)	Conc. mg/m³	HD rem. (%)
2.57	1.41E-01	99.67%
24.29	3.75E-02	96.18%
46.00	3.32E-02	94.80%
67.72	2.82E-02	93.60%
89.42	2.45E-02	92.57%
111.14	2.53E-02	91.59%
132.85	1.82E-02	90.74%
154.57	1.70E-02	90.05%
182.95	1.84E-02	89.15%
211.34	1.88E-02	88.20%
240.55	1.39E-02	87.34%
270.58	1.28E-02	86.61%
300.63	1.27E-02	85.92%
331.52	1.24E-02	85.22%
363.23	1.17E-02	84.53%
394.95	9.07E-03	83.94%
429.17	1.01E-02	83.35%
465.88	9.58E-03	82.70%
515.93	9.43E-03	81.84%
570.98	8.07E-03	80.97%
631.03	8.11E-03	80.10%
721.07	6.88E-03	78.88%
821.12	6.20E-03	77.70%
931.17	5.30E-03	76.56%
1051.22	5.37E-03	75.41%
1231.27	3.92E-03	73.90%
1441.32	3.92E-03	72.42%
1681.37	2.47E-03	71.04%
1921.40	2.22E-03	70.02%
2161.45	1.88E-03	69.13%

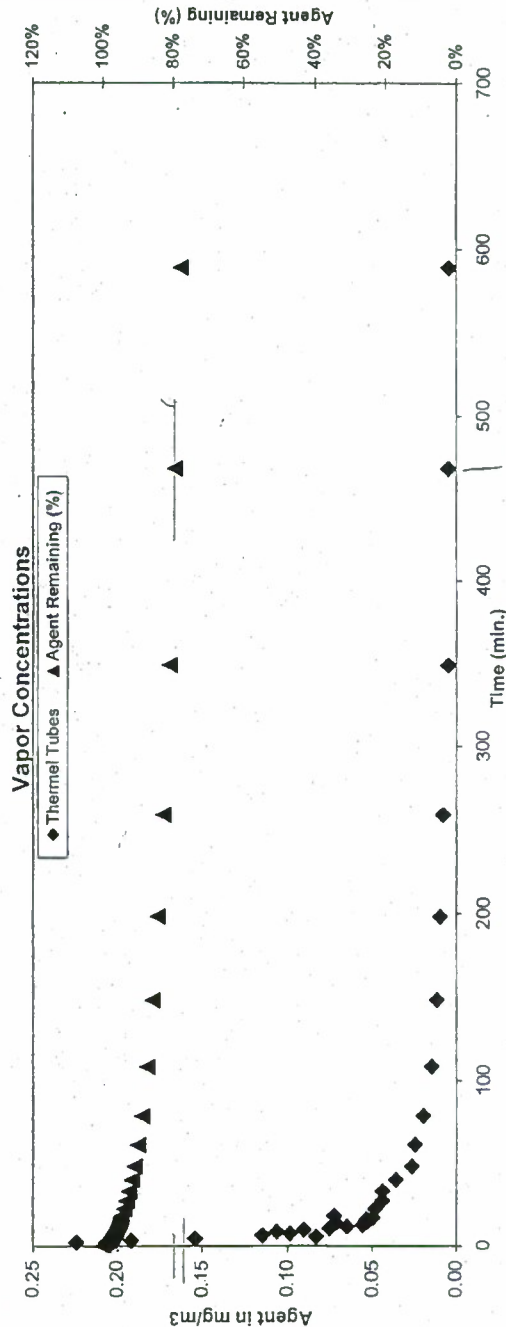


Data Evaluation Grade: **Test Grade (requires further evaluation)**

Tunnel:		3c
Instruments:	VTS#1/GCMSD	
Date/Experiment #:	08/07/06	156
Type of substrate :	Concrete(CZ04)	Purity
Test agent/purity:	H	78.2%
Number of drops:	1	
Nominal drop volume:	6 µL	
Mass of agent disseminated:	7.75 mg	
Corrected mass on 100% agent purity:	6.06 mg	
Average substrate temperature:	35.24 °C	
Average air temperature above drop:	35.49 °C	
Average air flow rate:	180.94 SLPM	
Test section air flow speed:	1.71 m/s	
Water vapor concentration:	0.00 g/m ³	
Crude Evap Rate:	13.0 ug/min	
Mass % recovery in vapor:	22.3 %	
Mass % recovery by extraction:	n/a %	
Total agent % mass recovery:	22.3 %	
Tube #s consistent:	Yes	
Daily CCV < +/- 15%:	Yes	

Data Evaluation	
SD	%SD
0.1	0.39%
0.1	0.37%
8.1	4.50%
-	-
	Status
	Go
	Go
	Flag
	Go

Time (min)	Conc. mg/m ³	HD rem. (%)
2.23	2.24E-01	99.25%
3.28	1.92E-01	98.60%
4.33	1.54E-01	98.06%
5.38	8.35E-02	97.68%
6.42	1.15E-01	97.38%
7.47	9.86E-02	97.04%
8.52	1.06E-01	96.72%
9.57	9.08E-02	96.41%
10.62	7.54E-02	96.15%
11.67	6.51E-02	95.93%
12.72	5.59E-02	95.74%
13.77	7.16E-02	95.54%
14.82	5.27E-02	95.35%
15.87	5.36E-02	95.18%
16.92	4.97E-02	95.02%
17.97	7.25E-02	94.83%
22.27	4.82E-02	94.05%
27.07	4.41E-02	93.39%
32.62	4.40E-02	92.66%
39.67	3.60E-02	91.82%
47.72	2.63E-02	91.07%
60.77	2.42E-02	90.09%
78.32	1.93E-02	88.94%
108.37	1.43E-02	87.44%
148.42	1.14E-02	85.90%
198.47	9.29E-03	84.35%
258.52	7.84E-03	82.82%
348.57	4.89E-03	81.10%
468.62	4.77E-03	79.37%
588.67	4.31E-03	77.74%



A10

Data Evaluation Grade: Test Grade (requires further evaluation)

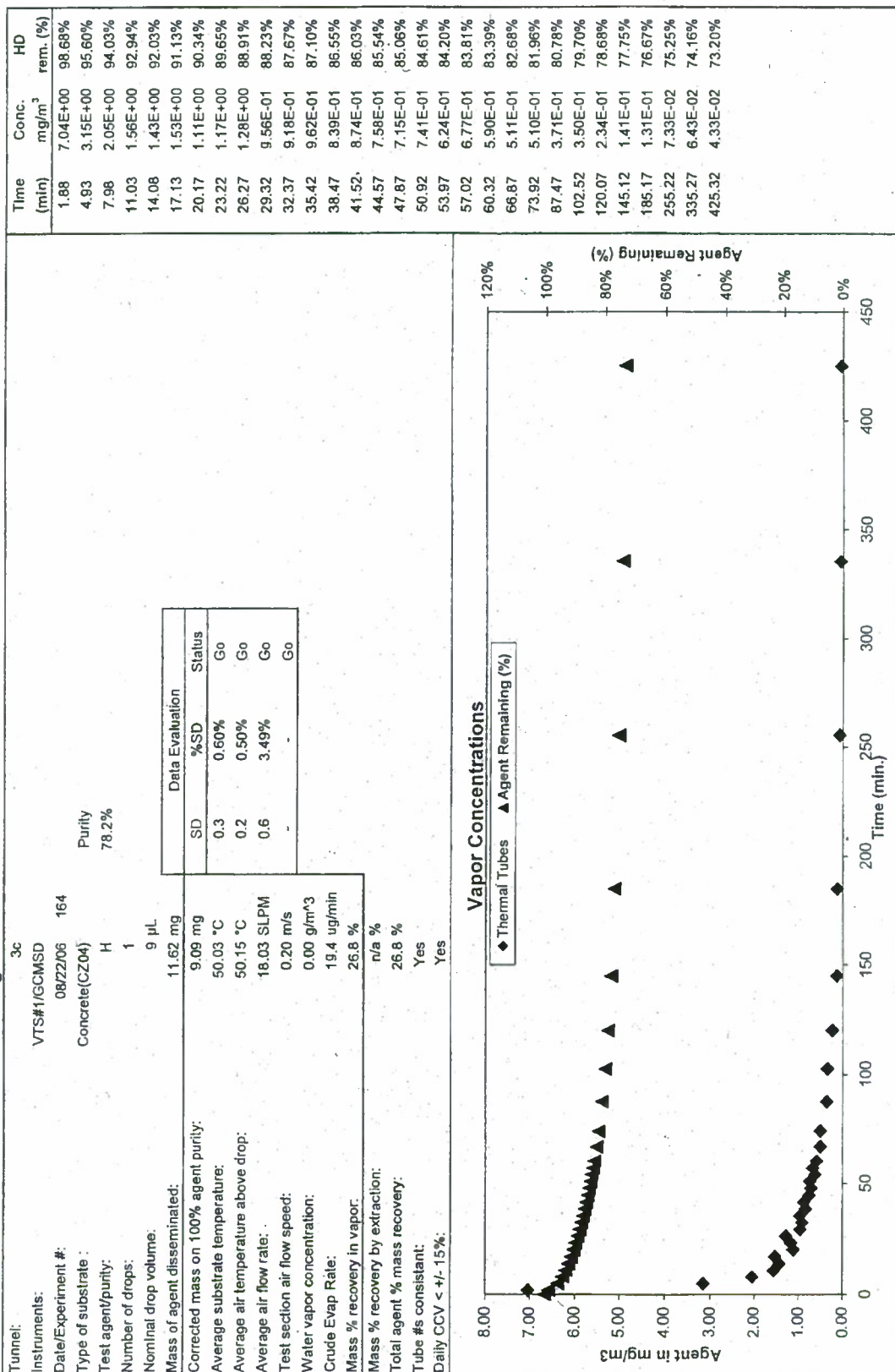
Tunnel: 3a		VTS#2/GCMUSD		114	
Instruments:		08/07/06		Concrete(CZ04)	
Date/Experiment #:		Concrete(CZ04)		Purity	
Type of substrate:		H		76.2%	
Test agent/purity:		1			
Number of drops:		6 µL			
Nominal drop volume:		7.75 mg			
Mass of agent disseminated:		6.06 mg			
Corrected mass on 100% agent purity:		35.17 °C		Go	
Average substrate temperature:		35.15 °C		Go	
Average air temperature above drop:		181.87 SLPm		Flag	
Average air flow rate:		1.73 m/s		Go	
Test section air flow speed:		19.44 g/m³			
Water vapor concentration:		54.3 µg/min.			
Crude Evap Rate:		21.8 %			
Mass % recovery in vapor:		n/a %			
Mass % recovery by extraction:		21.8 %			
Total agent % mass recovery:		Yes			
Tube #s consistent:		Yes			
Daily CCV < +/- 15%:					

Time (min)	Conc. mg/m³	HD rem. (%)
1.95	6.12E-01	98.21%
2.98	4.18E-01	96.61%
4.03	3.47E-01	95.40%
5.08	2.50E-01	94.46%
6.13	1.77E-01	93.79%
7.18	0.00E+00	93.51%
8.23	0.00E+00	93.51%
9.28	1.31E-02	93.49%
10.33	9.98E-02	93.31%
11.38	8.46E-02	93.02%
12.42	9.07E-02	92.75%
13.47	7.68E-02	92.48%
14.52	7.90E-02	92.24%
15.57	5.77E-02	92.02%
16.62	4.03E-02	91.87%
17.67	4.59E-02	91.73%
21.97	4.37E-02	91.15%
26.77	4.47E-02	90.51%
32.32	3.40E-02	89.85%
39.37	2.82E-02	89.20%
47.42	4.06E-03	88.81%
60.47	2.09E-02	88.32%
78.00	1.75E-02	87.30%
108.05	7.30E-03	86.19%
148.10	1.12E-02	85.07%
198.15	9.28E-03	83.54%
258.20	3.42E-03	82.39%
348.25	5.19E-03	81.23%
468.30	3.68E-03	79.63%
588.35	4.09E-03	78.23%

Vapor Concentrations

Legend: ◆ Thermal Tubes ▲ Agent Remaining (%)

Data Evaluation Grade: Modeling Grade

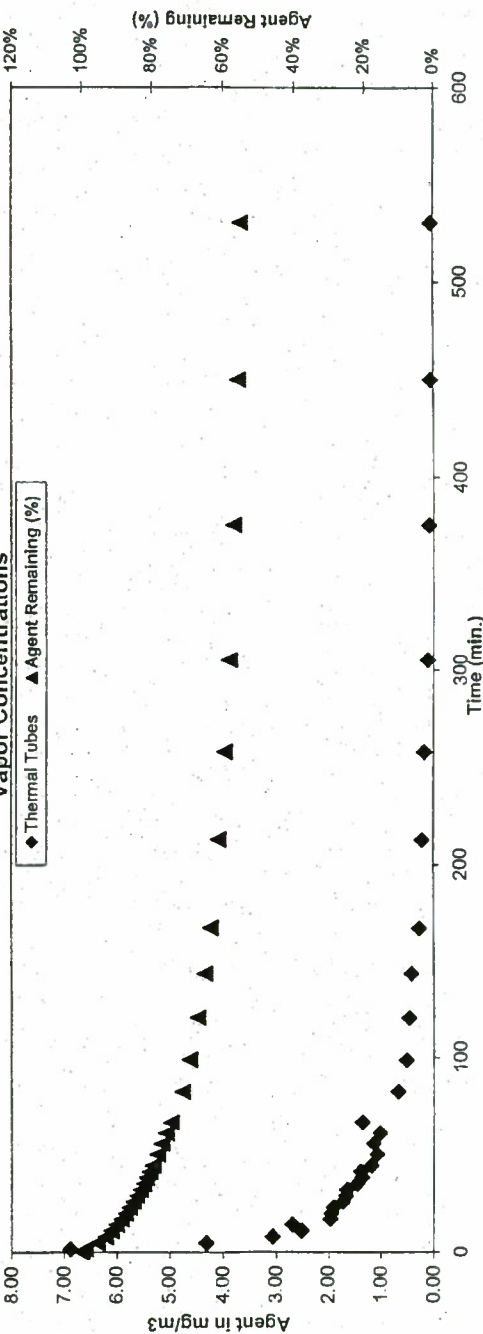


Data Evaluation Grade: Modeling Grade

Tunnel:	3c
Instruments:	VTS#1/GCMSD
Date/Experiment #:	08/23/06 165
Type of substrate :	Concrete(CZ04)
Test agent/purity:	H 78.2%
Number of drops:	1
Nominal drop volume:	9 µL
Mass of agent disseminated:	11.62 mg
Corrected mass on 100% agent purity:	9.09 mg
Average substrate temperature:	49.86 °C
Average air temperature above drop:	50.12 °C
Average air flow rate:	18.03 SLPM
Test section air flow speed:	0.20 m/s
Water vapor concentration:	0.00 g/m³
Crude Evap Rate:	36.0 ug/min
Mass % recovery in vapor:	45.0 %
Mass % recovery by extraction:	n/a %
Total agent % mass recovery:	45.0 %
Tube #'s consistent:	Yes
Daily CCV < +/- 15%:	Yes

Data Evaluation		
SD	%SD	Status
0.3	0.53%	Go
0.2	0.42%	Go
0.7	3.64%	Go

Vapor Concentrations



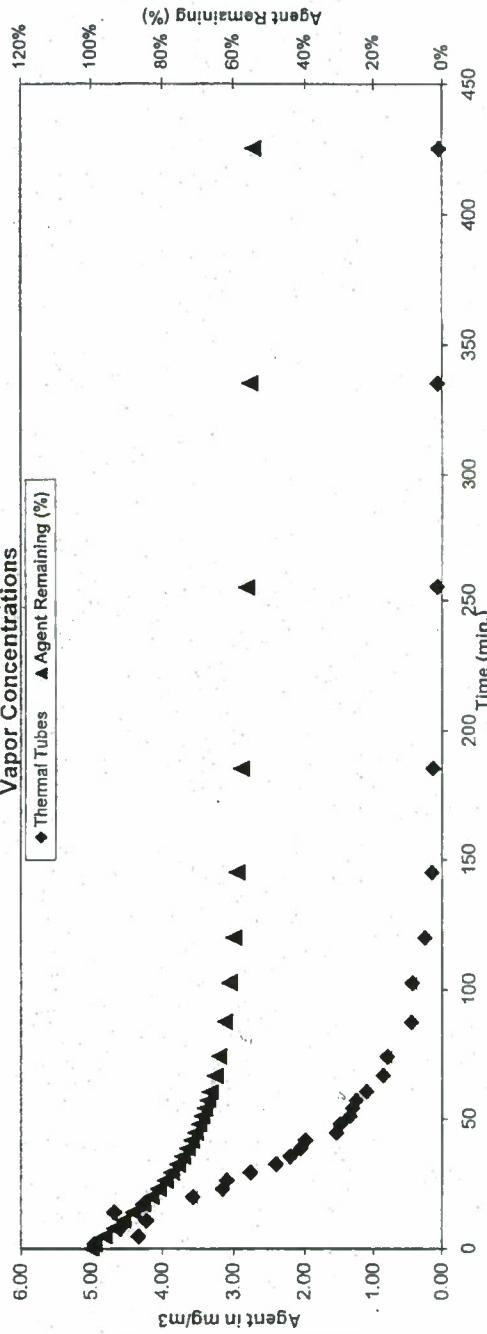
Time (min)	Conc. mg/m³	HD rem. (%)
1.60	6.88E+00	98.91%
4.65	4.32E+00	95.52%
7.70	3.07E+00	93.28%
10.75	2.53E+00	91.59%
13.80	2.70E+00	90.01%
16.60	1.97E+00	88.71%
19.65	1.95E+00	87.52%
22.70	1.91E+00	86.35%
25.75	1.73E+00	85.25%
28.80	1.67E+00	84.22%
31.85	1.66E+00	83.21%
34.90	1.47E+00	82.26%
37.95	1.38E+00	81.41%
41.00	1.40E+00	80.57%
44.05	1.20E+00	79.78%
49.85	1.09E+00	78.47%
55.40	1.15E+00	77.23%
60.95	1.03E+00	76.03%
66.50	1.38E+00	74.71%
82.30	6.81E-01	71.49%
98.85	5.30E-01	69.50%
120.90	4.71E-01	67.31%
143.45	4.28E-01	65.30%
167.50	2.78E-01	63.61%
212.55	2.20E-01	61.38%
257.58	1.75E-01	59.61%
305.13	1.13E-01	58.26%
375.18	8.94E-02	56.85%
450.23	5.31E-02	55.79%
530.28	4.34E-02	55.02%

Data Evaluation Grade: Modeling Grade

Tunnel:	3c
Instruments:	VTS#1/GCMSD
Date/Experiment #:	08/25/06 166
Type of substrate :	Concrete(CZ04)
Test agent/purity:	H 78.2%
Number of drops:	1
Nominal drop volume:	9 µL
Mass of agent disseminated:	11.62 mg
Corrected mass on 100% agent purity:	9.09 mg
Average substrate temperature:	50.57 °C
Average air temperature above drop:	50.15 °C
Average air flow rate:	18.05 SLPM
Test section air flow speed:	0.21 m/s
Water vapor concentration:	0.00 g/m ³
Crude Evap Rate:	73.9 ug/min
Mass % recovery in vapor:	45.6 %
Mass % recovery by extraction:	n/a %
Total agent % mass recovery:	45.6 %
Tube #'s constant:	Yes
Daily CCV < +/- 15%:	Yes

Data Evaluation		
SD	%SD	Status
0.1	0.23%	Go
0.1	0.24%	Go
0.3	1.77%	Go
-	-	Go

Vapor Concentrations



Time (min)	Conc. mg/m ³	HD rem. (%)
1.88	4.96E+00	99.07%
4.93	4.34E+00	96.26%
7.98	4.60E+00	93.55%
11.03	4.22E+00	90.88%
14.08	4.68E+00	88.18%
17.13	4.27E+00	85.47%
20.18	3.58E+00	83.09%
23.23	3.16E+00	81.05%
26.28	3.10E+00	79.16%
29.33	2.77E+00	77.38%
32.38	2.41E+00	75.81%
35.43	2.21E+00	74.41%
38.48	2.07E+00	73.11%
41.53	1.99E+00	71.88%
44.58	1.54E+00	70.81%
47.88	1.49E+00	69.82%
50.93	1.34E+00	68.96%
53.98	1.31E+00	68.16%
57.03	1.25E+00	67.38%
60.33	1.11E+00	66.61%
66.88	8.58E-01	65.33%
73.93	7.94E-01	64.17%
87.48	4.47E-01	62.50%
102.53	4.33E-01	61.19%
120.08	2.51E-01	59.99%
145.13	1.52E-01	58.99%
185.18	1.30E-01	57.87%
255.23	6.90E-02	56.48%
335.28	6.52E-02	55.41%
425.33	4.29E-02	54.45%

Data Evaluation Grade: Modeling Grade

Tunnel:		3c
Instruments:	VTS#1/GCMSD	167
Date/Experiment #:	08/29/06	(CZ04)
Type of substrate :	H	Purity 78.2%
Test agent/purity:	1	
Number of drops:	9 µL	
Nominal drop volume:	11.62 mg	
Mass of agent disseminated:	9.09 mg	
Corrected mass on 100% agent purity:	49.77 °C	
Average substrate temperature:	50.20 °C	
Average air temperature above drop:	18.03 SLPm	
Average air flow rate:	0.21 m/s	
Test section air flow speed:	0.00 g/m³	
Water vapor concentration:	48.8 ug/min	
Crude Evap Rate:	53.7 %	
Mass % recovery in vapor:	n/a %	
Mass % recovery by extraction:	53.7 %	
Total agent % mass recovery:	Yes	
Tube #s constant:	Yes	
Daily CCV < +/- 15%:		

Data Evaluation		
SD	%SD	Status
0.4	0.78%	Go
0.2	0.44%	Go
0.7	3.98%	Go

Vapor Concentrations

